

CONNECTICUT RIVER FLOOD CONTROL

ENGINEERING DIVISION RECORD COPY

DO NOT REMOVE FROM FILE

MANUAL OF OPERATION
AND MAINTENANCE

BIRCH HILL
AND
TULLY RESERVOIRS

MILLERS RIVER BASIN MASSACHUSETTS



CORPS OF ENGINEERS. U. S. ARMY

OFFICE OF THE DIVISION ENGINEER

NEW ENGLAND DIVISION, BOSTON, MASSACHUSETTS

JANUARY 1950

CONNECTICUT RIVER FLOOD CONTROL

MANUAL OF OPERATIONS

AND MAINTENANCE

BIRCH HILL

AND

TULLY RESERVOIRS

MILLERS RIVER BASIN MASSACHUSETTS

CORPS OF ENGINEERS U. S. ARMY

OFFICE OF THE DIVISION ENGINEER

NEW ENGLAND DIVISION, BOSTON, MASSACHUSETTS

JANUARY 1950

TABLE OF CONTENTS

Manual of Operation and Maintenance Birch Hill and Tully Reservoirs

<u>Introduction</u>	<u>Page</u>
 <u>Section I - Maintenance of Dam and Reservoir</u>	
1. Dam	
a. Slopes (Cover Rock, Gravel, Grass)	I-1
b. Gutters	I-1
c. Settlement Gages	I-1
d. Retaining Walls	I-1
e. Inspection During Floods	I-2
2. Outlet Structures and Spillway	
a. Concrete	I-3
b. Rip Rap	I-4
c. Grassed Slopes	I-4
d. Trash Racks	I-4
e. Log Booms	I-5
f. Gages (Excluding Recording)	I-5
g. Guard Rails and Fences	I-5
3. Gate House and Gate Operating Equipment	
a. Gate House (Roof, Masonry, Floors, etc.)	I-5
b. Gates and Guides	I-6
c. Crane	I-8
d. Standby	I-8
e. Electrical Equipment	I-9
f. Heating Plant	I-9
4. Access Roads	
a. Surfacing	I-10
b. Slopes	I-10
c. Drainage	I-10
d. Guard Rails	I-10
e. Bridges	I-10
5. Buildings	
a. Exterior of Buildings	I-10
b. Operator's Quarters	I-11
c. Toilets	I-11

	<u>Page</u>
6. Reservoir Area	
a. Roads	I-11
b. Fires	I-12
c. Removal of Dead and Down Timber	I-12
d. Cutting of Wood by Others	I-12
e. Farm and Pasture Land	I-13
f. "Squatting" or Trespassing	I-13
g. Hunting and Fishing	I-13
7. Mobile Equipment, Tools, Etc.	
a. General	I-14
b. Gasoline Engines	I-14
c. Fire Fighting Equipment	I-15
d. Snow Shoes	I-15
8. Summary of Periodic Duties	
a. Daily	I-16
b. Weekly	I-16
c. Monthly	I-16
d. Every Three Months	I-16
e. Every Six Months	I-16
f. Annually	I-17
9. Reports	I-17
10. Recommended List of Spare Parts and Fire Fighting Equipment	
a. Spare Parts	I-17
b. Fire Fighting Equipment	I-18
11. Miscellaneous	
a. Supervisory Responsibilities	I-19
b. Cooperation with Riparian Owners Downstream	I-20
c. Public Relations	I-21

Section II - Hydraulic Operation

1. General	
a. Scope	II-1
b. Purpose of Reservoirs	II-1
2. Reservoir Regulation Section	
a. General	II-1
b. Responsibilities	II-1

	<u>Page</u>
3. Operation of Reservoir	
a. Normal Periods	II-2
(1) General	II-2
(2) Operation During Freezing Weather	II-2
(3) Trash Removal	II-3
(4) Cooperation with Downstream Water Users	II-3
b. Flood Periods	II-3
(1) Observations of Flood Conditions	II-3
(2) Conditions that Warrant a Report	II-4
(3) Communications	II-4
(4) Scope of Report	II-4
(5) Operation of Both Reservoirs	II-5
(a) General	II-5
(b) Local Floods on Millers River	II-6
(c) Floods on the Connecticut River	II-7
(d) General Floods	II-7
(e) Emptying the Reservoir	II-7
(f) Operations if Communications Fail	II-9
4. Reports	
a. Normal Operation	II-9
(1) General	II-9
(2) Reservoir Stage	II-10
(3) Gate Operation Record	II-10
(4) Tailwater Gage	II-11
(5) Rainfall Data	II-11
(6) Snow Courses	II-11
b. Flood Control Operation	II-12
(1) General	II-12
(2) Observations at the Dam	II-12
(3) Observations at the Key Damage Control Points	II-12
(4) Resume of Operations	II-13

Plates

	<u>Plate No.</u>
Location Map of Connecticut River	1
Millers River - Map of Watershed	2
Birch Hill Reservoir Map	3
Birch Hill Plan and Sections	4
Tully Reservoir Map	5
Tully Plan and Sections	6
Key Damage Control Points	7
Athol Damage Control Points	8
Orange Damage Control Points	9
Millers Falls Damage Control Points	10
Birch Hill - Area and Capacity Curves	11

PlatesPlate No.

Birch Hill - Outlet Rating Curve	12
Birch Hill - Outlet Rating Curve for One Gate	13
Birch Hill - Spillway Rating Curve	14
Tully - Area and Capacity Curves	15
Tully - Outlet Rating Curve	16
Tully - Outlet Rating Curve for One Gate	17
Tully - Tailwater Rating Curve, U.S.G.S. Gaging Station	18
Tully - Spillway Rating Curve	19
Millers River - Near Winchendon - Rating Curve for U.S.G.S. Gaging Station	20
Millers River - At South Royalston - Rating Curve for U.S.G.S. Gaging Station	21
Millers River - At Irving - Rating Curve for U.S.G.S. Gaging Station	22
Curves for U.S.G.S. Stations	23

MANUAL FOR THE MAINTENANCE AND OPERATION OF
BIRCH HILL AND TULLY DAMS

INTRODUCTION

1. This manual has been prepared for the guidance of damtenders and others concerned with the maintenance and operation of the Birch Hill Dam on the Millers River and the Tully Dam on the Tully River. It is divided into two sections. Section I outlines the duties of the damtender with respect to maintenance of the dams and reservoirs, and is generally applicable to all flood control reservoir projects in the New England Division, Corps of Engineers. Section II provides detailed instructions for the hydraulic operation of these two dams and is not generally applicable to other projects.

2. It is the responsibility of the damtender to maintain his dam and its appurtenant works in operating condition at all times. Floods have occurred on the major New England rivers in every month of the year and his maintenance planning and execution must take account of this fact.

3. The Operations and Construction Division is responsible to the Division Engineer for the maintenance of dam and reservoir projects and damtenders are under the direct supervision of this Division. Regulation of discharges from the reservoirs is the responsibility of the Engineering Division. In the event of a flood, the damtender will receive instructions for the operation of the gates directly from the Chief of the Reservoir Regulation Section, Engineering Division, and is authorized to communicate directly with members of the Hydrology

Section for the purpose of reporting meteorological, stream and related data and for receiving instruction with respect to the operation of the gates. If communications are interrupted, the gates will be operated in accordance with schedule established in Section II of this manual.

4. No attempt has been made in this manual to cover by detailed instructions all the varied activities of the damtender in performing his mission. He must be alert and observant while performing his duties and when in doubt must resolve the doubts on the side of safety. Conditions which appear abnormal or undesirable must be promptly investigated and either corrected or reported. He must not gamble with safety, but obtain advice and assistance from higher authority without delay. When immediate advice or instructions are required, the telephone should be used.

5. The necessity for complete records cannot be overstressed. Full records on appropriate forms and in log books and diaries must be maintained. Care is required to see that they are clear and complete, particularly with respect to descriptions of unusual conditions and situations. (See sub-section 9 of Section I of this manual).

SECTION I - MAINTENANCE OF DAM AND RESERVOIR

1. Dam.

a. Slopes (Cover Rock, Gravel, Grass). The slopes of the dam, including those protected by rock or gravel, must be carefully watched for settlement or erosion. Slopes should be kept free from debris, and rock and gravel slopes kept free from vegetation. Burrowing animals constitute a hazard to any embankment. Although there is little probability of rodent holes beneath a rock fill which is bedded in gravel, the damtender should watch for rodents around the slopes and destroy them by poison, traps, gun or gas. Gravel slopes should be maintained in a smooth even plane. Grassed slopes shall be mowed three or four times a year in order to maintain a good sod.

b. Gutters. These should be kept in effective condition with displaced rock promptly replaced. Principal hazard is from erosion at edges, caused by flows beyond the capacity of the gutter. Failure is progressive and rapid.

c. Settlement Gages. Observations on settlement gages are to be made at six-month intervals until increments of settlement have become negligible. Survey parties will be sent to the dams for this purpose. Elevations will be taken to 0.01 foot; determinations will be made from two bench marks free from any disturbance.

d. Retaining Walls. In instances where the slopes are confined by a retaining wall, the wall will be inspected monthly with inspections progressively increased to daily when the pool level is equal to half

the height of the dam. Any movement, cracks or seepages through or around the wall must be noted and promptly reported.

e. Inspection During Floods. (1) The behavior of the dam during attack is of vital importance and interest. Periods of storage are the times of danger and, if weaknesses develop, it is essential that they be noted and prompt corrective action taken. The damtender must recognize that a condition which is of minor importance with a relatively low head may assume serious proportions with increasing pool levels, and he must be constantly alert to note and report even minor failures or changes in the conditions of the embankment. Results of a single careful inspection of the embankment during a flood can be more significant and valuable than a great number of equally careful inspections when the embankment is not impounding water.

(2) When the reservoir is filling or is storing water, the damtender will inspect the exposed faces of the dam with particular attention to the downstream face, the dam abutments and the area adjacent to downstream face of dam for "springs", sand boils, subsidences, sloughing of embankment or abutments, or other indication of leakage through, around, or under the dam. Any evidence of leakage or movement of material will be immediately reported, particularly where leakage, even though slight, appears to develop at an increasing rate.

(3) When the reservoir is being drawn down, the damtender will inspect the exposed faces of the dam, with particular attention to the upstream face and abutments, for slides or indications of incipient slides. On the dam proper, the guard rails on top of the

dam, if well aligned, will provide a means to detect lateral movement of the dam top that may precede a slide. Any evidence of slides or incipient slides shall be reported immediately.

(4) During the first filling of the reservoir, and each time the reservoir is filled to a higher level than previously experienced, inspection of the downstream area will be particularly detailed and conducted at least twice daily and at least three times weekly until two weeks after completion of drawdown. During subsequent filling, storage and drawdown periods, inspections of the embankment may be conducted less frequently but when within 12 feet of the top of the spillway, never less than once a day during filling and storage nor once a week during drawdown.

2. Outlet Structures and Spillway.

a. Concrete. The concrete structures shall be carefully inspected at intervals of six months and after each major filling operation. The inspection shall include a survey of the general conditions of the concrete surfaces, noting location and extent of cracks, crazing and spalling, and other type of deterioration or disintegration that may have developed. Surfaces adjacent to cracks should be inspected for differential movement; similar inspections shall be made of construction and expansion joints. Any point or points of leakage should be noted and the condition of all water passages inspected for evidence of erosion or cavitation. The exposed portion of embedded items and the concrete adjacent thereto shall be carefully inspected. Any condition requiring or suspected to require corrective action will be brought to

the attention of the Division Office immediately. The inspection shall be made a matter of record with report submitted to the Division Office including a sketch showing the location and nature of the defects.

b. Rip Rap. Rip rap should be kept free from debris and vegetation; dislodged stones must be promptly replaced.

c. Grassed Slopes. Monthly inspections shall be made of all grassed slopes and other grassed areas to note subsidences, slides, erosions, etc. Corrective action in the form of drains, pervious blankets, etc. will be directed by the Division Office when the failures or incipient failures are of substantial magnitude. All grassed areas will be mowed at least once a year. On many areas it will be necessary to mow twice a year to improve appearance and discourage the growth of weeds. When necessary to reestablish turf, the seeding operation should start at the earliest practicable date in the spring to obtain the greatest possible protection against erosion. Areas requiring seeding should be dressed to proper grade, and irregularities in the surface removed. The surface should then be raked or harrowed parallel to the contour of the slope (never up and down) to a depth of three-quarters of an inch. Debris should always be removed promptly; deposits of debris are unsightly, detrimental to the growth of grass and encourage the nesting of rats and other burrowing animals.

d. Trash Racks. When the flow through the trash racks is at a minimum in the summer, trash racks shall be inspected and painted as required. All debris collecting at the racks shall be removed, either by pushing the smaller pieces through the racks or, in the case of the

larger pieces, by either lifting them up onto the raking platform or removing them from the intake channel by boat or otherwise.

e. Log Booms. Log booms shall be inspected monthly for broken logs, or evidences of rot near the holes that contain the ends of the boom chains, damaged cables, or chains, etc. During attack the booms will be stressed very severely and must be at full strength at all times. Spare boom logs should be kept on hand at all times.

f. Gages (Excluding Recording). Staff gages shall be inspected every spring and fall to insure that they are securely fastened, clean and otherwise in usable condition. When necessary they will be removed, repainted and reset by the damtender. In the case of disturbance by drift or from other causes the gage will be reestablished or checked by leveling, and the leveling notes made a matter of record. Complete check of the several sections should be accomplished in connection with the leveling required under subparagraph "c", "Settlement Gages".

g. Guard Rails and Fences. Guard rails and fence posts will be painted black on the lower portion near the ground and white on the top. All fence rails will be painted white. Decayed wood posts or rails should be replaced and wire cable kept at the proper tension.

3. Gate House and Gate Operating Equipment.

a. Gate House (Roof, Masonry, Floors, Hatches, Ladders, Windows, Doors, Rails, Gratings). The gate house must be kept neat and clean at all times. General house cleaning should be accomplished about once a week, to include such sweeping, washing and cleaning as may be necessary.

Twice a year a careful inspection of the entire gate structure should be made. Notes should be made of such things as cracks in the masonry or concrete, broken glass blocks, spalling of concrete, roof leaks, etc. Special notes should be made relative to leakage through masonry, condensation on walls, ponding of water on floors, etc.

Insects may be disposed of by periodic spraying with a strong solution of DDT.

All metal work on equipment, gratings, railings, ladders, etc. will be kept neatly painted. Windows shall be kept well flashed. Front entrance doors should be examined, particularly on the top, for holes. The metal doors should be completely sealed to prevent the entrance of moisture which would corrode the door from the inside. All holes should be promptly sealed. Metal doors may be enameled by brush; if proper care is taken to spread the enamel smoothly, a satisfactory appearance will be obtained.

b. Gates and Guides. Operation of each gate should be tested weekly. Every three months, or more often if required, the gates and hoists should be thoroughly lubricated. The gate stems should be greased to prevent friction in the guide bearings. The threaded portions of the gate stems should be kept well greased and free from dirt at all times.

Hoisting cables should be carefully examined for wear every three months and should be painted with lubricant as required.

Twice a year the damtender should check each gate when fully closed for leakage and proper seating.

During operation of the gate hoists, the temperature of the bearings should be constantly checked. Wear on gear teeth and brake shoes should be carefully noted. Limit switch contacts should be kept clean and free from pitting and corrosion. The closing setting of the limit switches on gate floorstands should be checked each week; stretching of the cables will necessitate periodic adjustments of the limit switches. These switches should be so adjusted that the weight of the gate is off the cables when the gate is in a closed position; however, serious damage to the cables will result if the cable is allowed to become loose enough to fall off the sheaves of the lower block.

Floorstand motors should be oiled once each year. Excessive oiling of the motor bearings should be avoided since excess oil will damage the motor windings. The end bearings and the worm in the limit switches should be oiled with a few drops of S.A.E. 20-W oil once each year.

Guides should be spot-painted as required. At yearly intervals the seals on the frames of all gates, and the roller pads on all gates should be inspected and cleaned if necessary. No paint should ever be applied to these surfaces as increased friction would result. The roller pads on Broome gates installation extend from the gate sill to a distance above the top of the conduit equal roughly to the height of the gate. These pads are a hardened stainless steel and paint should never be applied to them.

c. Crane. Each travelling crane should be operated throughout its various functions once each week. These functions include the bridge traverse, the trolley traverse, the raising and lowering of the hook in all its speeds. Once each three months the crane should be thoroughly lubricated.

Uncovered conductors for transferring energy from the building to the bridge or from the bridge to the trolley should be scraped once a year to prevent corrosion from destroying the contact.

d. Standby. Standby units should be operated for a period of two hours each week. Before and after each weekly run the level of the water in the radiator and the oil in the crankcase will be checked. Once each month the storage battery, air cleaner, oil filter and fuel pump should be carefully inspected according to the instructions furnished by the engine manufacturer. After each run, the exhaust piping should be drained of condensate, as this condensate, if allowed to accumulate in the exhaust piping, will run back into the engine, causing damage to the valves and cylinders. The crankcase oil should be changed in the spring and fall, or when the oil becomes badly discolored or diluted. The operation and maintenance of standby units should be in accordance with the manufacturer's manual of instructions. The weekly testing of equipment should be done while the standby unit is being operated, with the standby furnishing all the energy. This will condition the equipment by loading the generator, reduce the bills for electrical energy and provide a check on the operation of the governor and voltage regulator.

e. Electrical Equipment. Once every month (except at Tully) the outside power line should be inspected from the building to the point where it joins with the main power line. Steps should be taken to eliminate any possible sources of future trouble, such as bad poles, overhanging trees, torn insulation, etc.

In the event of malfunction of the control board, the Division Office should be notified immediately and an electrical engineer will be dispatched to the dam. Under no circumstances will any work be attempted behind the control panel without throwing the main power switch.

All the electrical equipment at each of the dams will be tested every six months by an electrical engineer dispatched by the Division Office. Any pieces of equipment with a low resistance will be carefully examined and the condition corrected if possible. Should more than minor repairs be required, the condition of the equipment and recommended repairs will be reported promptly to the Division Office.

f. Heating Plant. The combustion chambers and flues should be cleaned at the start of each heating season by a heating service man. At this time the oil burner and all controls should be cleaned and checked over. The damtender should clean the boiler yearly by blowing off the mud valves and flushing out the boiler thoroughly. Monthly, the water feeder and low water cutoff should be tested and cleaned by drawing off a pail of water from the water feeder.

4. Access Roads.

a. Surfacing. Roads will be resurfaced periodically with the type of wearing surface with which roads were originally constructed. Dam-tenders will be responsible for keeping road surfaces sealed by application of a bituminous material.

b. Slopes. Slopes will be kept in a well-maintained condition as outlined for slopes under 2 c.

c. Drainage. Culverts and gutters shall be kept cleaned out at all times. Partially collapsed gutters should be replaced in the working season following failure; a completely collapsed culvert shall be replaced immediately. In the winter, openings shall be made in the snow on all grades at frequent intervals, to permit water to run into the ditches.

d. Guard Rails. Maintenance shall be the same as for guard rails listed under 2 g.

e. Bridges. Bridges shall be inspected yearly to determine condition of the paint, or to note evidences of damage or incipient failure. Damtenders should repaint any parts of the metal that become bare that may be reached safely. Periodically, bridges will be completely repainted either by contract or by hired labor.

5. Buildings.

a. Exterior of Buildings. Buildings will be maintained in good condition in accordance with general standard practice. The following covers general items to be observed:

- (1) Roofs inspected yearly and repaired as necessary.

(2) Chimneys, brick and stone masonry kept well pointed.

(3) Gutters shall be cleaned out periodically and kept well painted, on the inside as well as on the outside.

(4) Windows kept well glazed, with broken panes promptly replaced.

(5) Exterior of building painted periodically for the protection of the wood and to present a neat appearance. All wood buildings shall be painted white with black trim.

b. Operator's Quarters. Damtenders should bear in mind that they are tenants on Government property and are responsible for all damage beyond reasonable "wear and tear". Damage to wallpaper, plaster, trim, fixtures, etc. will be avoided or repaired. Leaks in plumbing and heating systems shall be promptly fixed. Heating systems should be checked and maintained in conformity with previous instructions with respect to systems in the gatehouses.

c. Toilets. Toilet rooms and fixtures will be kept scrupulously clean. Soap, paper towels in dispensers, and metal wastebaskets will be provided in all wash rooms. Rest rooms open to the public should be kept clean and all accessories provided at all times.

6. Reservoir Area.

a. Roads. Roads throughout the reservoir area, except those still the responsibility of local agencies, will be kept open and in passable shape to the extent practicable, but particularly in the season of forest fires in order that they may be used for fire fighting and inspections. Holes and bad ruts should be kept filled in and

bridges kept in repair. Brush should be kept trimmed back and if possible cut back a sufficient distance so that a swath may be cut on each side of the road with a tractor once a year to prevent the growth of brush.

b. Fires. During times when there is a danger of forest fires, the damtender will be on the alert for fires in the reservoir. He should be familiar with all sources of water in the reservoir area and during the dry season should have up-to-date information as to the availability of water. In areas distant from the river, water holes in low areas should be developed to provide a supply. Existing water holes should be kept well cleaned out. A substantial fence should be kept around all water holes for purposes of safety.

c. Removal of Dead and Down Timber. The reservoir area, particularly in the lower levels, should be kept cleared of all down and dead timber. This may be disposed of by burning the slash and the timber which is of no value; it may be cut into four-foot lengths and used by the damtender; or, if any merchantable or saleable quantities are available, it will be sold by the Property Section of the Division Office.

d. Cutting of Wood by Others. All wood in the reservoir area, as well as other natural resources, is Government property. Therefore, the damtender is not authorized to permit any person or persons to remove any wood from the reservoir area or to countenance such removal. Persons desiring to cut wood should be advised to write to the Division Engineer, furnishing details of his proposal, including information on the size, species, quantity, location, etc. together with an offer.

e. Farm and Pasture Land. It is the policy of the Division Office to lease as much land as possible in the upper portion of the reservoir area for whatever purposes the land is best suited and which are not inconsistent with use of the reservoir. Leases are executed by the Real Estate Division and use under the lease will be supervised by the damtender. It is to the advantage of the Government to encourage the leasing of fields in the reservoir area for pasturing cattle or for the cutting of hay. This will discourage undergrowth and the growth of trees with the result that expenditures for maintenance on these areas will not be required. On fields not leased the damtender will attempt to keep bushes and trees cut. Under no circumstances are structures for habitation or the shelter of stock to be built within the reservoir area.

f. "Squatting" or Trespassing. "Squatting" or unauthorized entry and occupation is not permitted on any Government property. Any persons found "squatting" on the reservation should be informed that Government regulations do not permit their remaining on Government property. The failure of any persons warned to promptly vacate will be reported to the Division Office. Camping may be allowed within the reservation provided proper precautions against fire are taken, no damage is done to Government property, and the site is left in a clean condition. Camping will be discouraged or forbidden when conditions are favorable to forest fires.

g. Hunting and Fishing. The streams are open to the public for fishing, subject to the laws, rules and regulations of the State,

enforced by the State game wardens. Hunting will be allowed within the reservoir area during the proper seasons by duly licensed persons and game laws will be enforced by the local game wardens. The damtenders will report incidents which indicate the desirability or necessity for changing these rules.

7. Mobile Equipment, Tools, Etc.

a. General. The maintenance and operation of a flood control dam requires a substantial amount of property, tools and equipment. It is the policy of the New England Division to provide the damtenders with sufficient tools and equipment to properly maintain and operate the dams, related structures and reservoir with a maximum of efficiency. The damtenders must bear in mind that the more tools and equipment they acquire, the greater the problem of maintenance and repair of the tools and equipment.

All equipment must be kept clean and in good working order at all times. Tools with an edge should be kept sharp. Broken handles on axes, shovels, hammers, etc. should be promptly replaced.

b. Gasoline Engines. All equipment normally will be overhauled during the winter season to place it in condition for the working season. During this time crankcases on gasoline engines may be removed and bearings, clutches, and heads of engines removed, carbon cleaned, and valves ground when necessary. Every six months a compression test shall be taken on all cylinders of all gasoline engines including all cars and trucks. These tests shall be taken first with each cylinder in normal operating condition and then after injecting

some heavy oil into the cylinder to seal the rings. These tests should be recorded on duplicate forms, one copy for the damtender's files and the other to be forwarded to the Division Office.

c. Fire Fighting Equipment. All fire fighting equipment must be kept in instant readiness for operation at all times. Carbon tetrachloride fire extinguishers will be kept filled and tried monthly by pushing the plunger until one squirt comes out. At least four fire rakes will be kept at each dam in a place readily accessible.

Most of the dams are provided with portable fire pumps with a complement of accessories and 1-1/2" hose. These pumps should be assembled with their accessories once a month (except during the freezing weather) and run for a short time. Subparagraph 10 b. includes a list of the equipment to be included with the portable fire pumps. All of the equipment given in the list should be kept in one place and ready for instant use at all times. It must be borne in mind that when this equipment is needed, the personnel sent to get it will be excited and hurried, and unless all the equipment is grouped in one place, some important item may be overlooked, resulting in serious delay.

d. Snow Shoes. After the winter period, snow shoes should be wiped clean, the wood and webbing varnished with high grade spar varnish, and stored. Two thin coats of varnish are preferable to one thick one. The shoes should be tied securely, back to back, and a block of wood forced into the space between the toes. They should be placed out of the sun and suspended by a wire so that mice or squirrels cannot get at them.

8. Summary of Periodic Duties.

- a. Daily. (1) Water surface reading from water level recorder.
(2) Precipitation reading from rain gage - raise pen.
(3) Read and record thermometer values.
(4) Record weather observations on U.S.W.B. Form 1009.
(5) Clean rest rooms.
(6) During period of flood flows check operation at all downstream USGS gage recorders.
- b. Weekly. (1) Operate standby unit to provide power for tests.
(2) Move each service gate at least two feet. Lower service gates to closed position (except Franklin Falls in winter).
(3) Check setting of floorstand limit switches.
(4) Test travelling crane.
(5) Operate motor-generator unit for two hours.
(6) Change rain gage and pool elevation charts.
(7) Inspect U.S.G.S. gaging station.
(8) During periods of normal flows check downstream U.S.G.S. gage recorders.
(9) Clean gate house.
- c. Monthly. (1) Inspect reservoir area.
(2) Operate each emergency gate at least two feet; disengage and replace lifting beam.
(3) Lower service gates to closed position (except at dams where no winter pool is maintained). Standby unit to be used for this operation.
(4) Inspect battery, air filter on standby unit.
(5) Inspect power and telephone lines.
(6) Change rain gage and pool elevation charts.
- d. Every Three Months. (1) Grease hoist bearings and lubricate crane.
(2) Raise Broome gates to intermediate floor level, inspect, lubricate and spot-paint as required.
(3) Close emergency gate, then return to normal position.
This operation to be rotated; i.e., gate to be lowered in different well each period.
- e. Every Six Months. (1) Inspect gate house.
(2) Inspect tunnel (except at Franklin Falls).
(3) Inventory of property.
(4) Settlement gage reading including water surface elevation within settlement gage.
(5) Change crankcase oil in standby unit.
(6) Inspect spillway.
(7) Check setting of limit switches on Broome gate hoists, and after each flood.
(8) Record compression readings on all gasoline engines.

- f. Annually. (1) Check seal of each gate under a head of at least ten feet (except at Franklin Falls where check should be made when Eastman Falls pool is drained).
- (2) Oil end bearings and worm in floorstand limit switch.
 - (3) Winter-charge rain gage.
 - (4) Spot-paint service bridge.
 - (5) Inspect tunnel at Franklin Falls Dam.

9. Reports.

- a. Daily Log. A daily log or record book will be maintained by the damtender. Entries should be made daily and should include notes of all activities outside of normal routine. The entries should be complete and should provide a record of all consequential events concerning the dam and reservoir area.
- b. Weekly meteorological reports.
 - c. Weekly gate operation and pool elevation report.
 - d. Monthly report of maintenance.
 - e. Monthly receiving report for electrical service.
 - f. Monthly man hour report.
 - g. Monthly motor vehicle report.
 - h. Monthly record of tailwater gage.
 - i. Monthly rainfall data.
 - j. Monthly climatological report.
 - k. Snow course reports as required.
 - l. Flood control observations after each operation for flood control.

With the exception of "Daily Log", the above listed reports and records are submitted on prepared forms which are self-explanatory.

10. Recommended List of Spare Parts and Fire Fighting Equipment.

- a. Spare Parts. Each dam should have as a minimum a store of the following spare parts:

(1) Gasoline Electric Generator Unit

a. Engine:

- (1) Fuel Pump
- (2) Set of points for battery distributor
- (3) Rotor for battery distributor
- (4) Distributor cap for battery distributor
- (5) Condenser for battery distributor
- (6) Set of points for magneto
- (7) Condenser for magneto
- (8) Coil
- (9) Fan belt
- (10) 2 exhaust valves

- (11) 4 valve springs
- (12) 2 intake valves
- (13) Head gasket
- (14) Complete set of manifold gaskets

b. Generator:

- (1) Set of brushes for exciter
- (2) Set of brushes for generator field
- (3) 2 springs for exciter brushes
- (4) 2 springs for generator field brushes

(2) Gate Hoists (Broome or Slide)

- a. 2 coils for motor starters
- b. 6 sets of contacts for motor starters

(3) Crane

- a. Set of brushes for wound rotor motor
- b. Spare set of contacts for each magnetic starter
- c. Spare coil for each motor starter

(4) Electrical

- a. 12 fuses of every size used on job
- b. 100 feet of No. 12 - 600 volt wire
- c. 2 rolls rubber tape
- d. 2 rolls friction tape
- e. Spare floodlight bulbs
- f. Fuse puller

b. Fire Fighting Equipment. Each dam that has a portable fire pumper will keep the following standard equipment complement, stored in an easily accessible place along with the pumper:

- (1) 10 batteries, flashlight
- (2) 1 small tool box
- (3) 1 oil can, squirt
- (4) 1 five-gallon can, Protectoseal, filled with four gallons of regular gasoline
- (5) 1 pump backpack carrier
- (6) 2 starting cords
- (7) 2 flashlights
- (8) 1 2" oil funnel
- (9) 1 screened funnel
- (10) 50 hose gaskets, 1-1/2"
- (11) 1 one-pound can of cup grease
- (12) 1 pean hammer

- (13) 2 flexible gasoline hoses
- (14) 1000 feet of 1-1/2" linen hose
- (15) 50 feet of 1-1/2" rubber lined hose
- (16) 2 eight-foot lengths of 1-1/2" suction hose
- (17) 1 first aid kit, filler only
- (18) 1 pint oil measure
- (19) 2 nozzles, 1-1/2"
- (20) 6 quarts of oil (outboard motor oil - SAE 30), in cans
- (21) 1 beer can opener
- (22) 1 galvanized pail
- (23) 1 pair of adjustable pliers
- (24) 2 pounds of rags
- (25) 1 screwdriver
- (26) 2 sets of sparkplugs (extra)
- (27) 1 suction strainer, 1-1/2" (disc type)
- (28) 1 5-gallon gasoline tank (empty)
- (29) 2 rolls friction tape
- (30) 1 check and bleeder automatic valve
- (31) 1 pressure relief valve (this may be in combination with the automatic check valve)
- (32) 2 bleeder valves
- (33) 1 Siamese valve
- (34) 2 Wescott type wrenches
- (35) 1 set of ignition wrenches
- (36) 1 pump wrench
- (37) 1 sparkplug wrench
- (38) 2 spanner wrenches

11. Miscellaneous.

a. Supervisory Responsibilities. Damtenders will, in general, be supervising from one to several employees. They must make sure that all employees know just what is expected of them and must see that all employees carry out their duties in a workmanlike manner.

The damtender should plan all the work for his employees ahead of time and procure all necessary materials and equipment so that when employees get through one job they can be instantly assigned to another job. The day's work should be laid out before the start each morning.

A good supervisor will so plan his work that one job works in well with another. Small jobs such as cleaning rooms, or wiping of

engines, can be done in a slack time when a larger job has been finished an hour or so before quitting time.

The work should be scheduled during the year so that the work to be accomplished inside of buildings may be performed in the winter months. These jobs include overhauling gates which can be hauled within a heated building; overhauling and repairing of equipment; painting of boats, equipment and the walls and floors of buildings.

In the summer the damtender should have a list of projects planned, both for outdoor work and indoor work. Thus when the weather permits, the outdoor work can be vigorously prosecuted and on rainy days the indoor jobs and cleaning and maintenance work can be accomplished.

The flood control dams are constructed for use in emergencies and must be ready to operate at any time. The rules and instructions given in this book are for the purpose of making the damtender keep the equipment and dam in such shape that it will be ready for any emergency and for the purpose of making the damtender operate the equipment at sufficiently frequent periods to insure any deficiencies in the equipment will be discovered during maintenance operations and not during a flood.

The failure of equipment during a flood, or the failure of fire-fighting equipment in an emergency, will reflect serious discredit upon the damtender.

b. Cooperation with Riparian Owners Downstream. The damtender should acquaint himself with the property adjacent to the river down-

stream of the dam in order to definitely determine the amount of water which may be released without serious damage. The location of basements which may be flooded and crops which may be destroyed should be known. It is very important that he know the extent of damage which may occur at various stages of the discharge channel. The property owners should be contacted and advised in a cooperative and friendly manner of the necessity for periodic release of flood waters. They should be advised of the hazard to crops planted in low areas and of the danger in erecting buildings or of storing materials in locations exposed to flood damage. Warnings should be issued in the event of any anticipated heavy discharge. In no event will definite commitments be made or property owners assured that the discharge will be kept down to bank-full levels. Conditions may make this impossible and riparian owners should be so informed. However, they should also be given to understand that it is the aim to keep damage to a minimum.

c. Public Relations. Damtenders should always bear in mind that they are representing the Corps of Engineers, U. S. Army, and that people within a radius of many miles think of him in that capacity. He must be diplomatic and careful in his statements, or he will find that observations lightly or facetiously made, are given disproportionate weight and publicity, very much to his embarrassment and that of the Division.

Damtenders are to be pleasant and courteous in their dealings with the public. They are expected to know, generally, the reasons for the main features of the dam, what purpose they serve and why they were

so constructed. Damtenders are not expected to maintain "open house" all the time at the dam to show visitors around. However, if representative groups wish to arrange to inspect the structures, the damtenders should accompany them. If public officials or visitors having more than a curious interest visit the dam, the damtender should conduct them over the project and explain as much as possible the functions of the dam. He should take pride in his job, for it is a responsible one, and in his organization; the result will be public confidence in him, the structure and the organization.

Owners of adjacent property and riparian residents who may be affected by reservoir operations should be treated in a friendly and tactful manner. Proper questions should be civilly and reasonably answered. We have nothing to hide. Explanations should be made in manner and detail as to preclude misunderstanding and subsequent criticism. Towns and police should be advised about possible flooding, to alert them concerning possible danger, but forecast of cresting or extent of damage will be avoided.

SECTION II - HYDRAULIC OPERATION

1. General.

a. Scope. - It is the purpose of this section of the manual to prescribe the basic regulations for hydrologic reporting and the hydraulic operation of Birch Hill and Tully Reservoirs during periods of normal and flood flows. This section of the manual will serve as a guide and ready reference for the use of the Reservoir Regulation Section in the Boston Office of the New England Division as well as for the individual damtenders.

b. Purpose of Reservoirs. - The purpose of Birch Hill and Tully Reservoirs is to provide flood protection for the downstream communities of Athol, Orange, Wendell Depot, Erving, and Millers Falls within the drainage basin of the Millers River, and, in conjunction with other flood control reservoirs in the Connecticut River Basin, to alleviate damage in the urban and industrial centers along the banks of the Connecticut River downstream from the mouth of the Millers River.

2. Reservoir Regulation Section.

a. General. - In order to coordinate reservoir operation during floods, the Hydrology and Hydraulic Section in the New England Division Office is henceforth designated the Reservoir Regulation Section.

b. Responsibilities. - The Reservoir Regulation Section is responsible for the hydraulic operation of all reservoirs. The damtenders are responsible for observing and reporting all

hydrologic conditions that may result in reservoir operation and shall operate the outlet works in accordance with instructions received from the Chief of the Reservoir Regulation Section or his designated assistants. To eliminate duplication of reporting and to take advantage of the close contact between the two damtenders, all reporting and instructions between the Tully damtender and the Reservoir Regulation Section will be relayed through the Birch Hill damtender. In the event communications fail during a flood period, the damtender at Birch Hill will direct the operation of both reservoirs in accordance with paragraph 3 b (5) (f).

3. Operation of Reservoir.

a. Normal Periods. - (1) General. - The gates of both reservoirs will normally be open with the reservoirs empty. Approval shall be obtained from the Chief, Reservoir Regulation Section, if it is desired to store water for any reason, and retention of the pool should be held to a minimum period of time with the reservoir being emptied as rapidly as possible maintaining safe downstream channel capacities as outlined on Plate No. 7. Complete records shall be made of all gate operations.

(2) Operation During Freezing Weather. - Due to the limited storage capacity of the Birch Hill Reservoir, maintenance of a pool to prevent the gates from freezing will not be allowed. However, at Tully a pool may be maintained at a gage height of 11.0 feet to facilitate gate operations during the winter months.

(3) Trash Removal. - Approval from the Chief, Reservoir Regulation Section shall be obtained for raising the pool elevation to facilitate trash removal. Sufficient water must be provided to satisfy minimum requirements of downstream water users.

(4) Cooperation with Downstream Water Users. - It is the policy of the Department to cooperate, whenever possible, with downstream manufacturers, town or city police, and other interested parties and agencies. The damtenders may be requested by the downstream water users to modify the river flow to facilitate downstream repairs, or to alleviate unusual circumstances. Whenever a request for such a modification is received, the Birch Hill damtender shall ascertain the validity of the request and obtain assurances from all other downstream water users that they are agreeable to the proposed operation. The damtender will then relay the information to the Reservoir Regulation Section for instructions and will direct the operation of both dams accordingly.

b. Flood Periods. - (1) Observations of Flood Conditions. - The United States Weather Bureau and other cooperating agencies furnish information to the Reservoir Regulation Section, relative to general storm and snowmelt conditions, and river stages throughout the Connecticut River Basin. It will be the responsibility of the damtenders to maintain up-to-date information on runoff conditions and river stages within the Millers

River Basin. To assist the damtenders to recognize critical conditions, Plates 7 to 10 are included to indicate damage stages at key damage control points.

(2) Conditions that Warrant a Report. - Whenever any of the following critical conditions are observed, they should be reported promptly to the Reservoir Regulation Section:

(a) Occurrence of one inch of precipitation in 24 hours.

(b) River stages approaching channel capacity at any one of the key damage control points.

(c) If Birch Hill or Tully pool is rising rapidly.

(3) Communications. - The Birch Hill damtender, and the Tully damtender if unable to contact Birch Hill, shall communicate directly with any member of the Reservoir Regulation Section, as listed below:

<u>Name</u>	<u>Designation</u>	<u>Office Telephone</u>	<u>Home Telephone</u>
Elliot F. Childs	Chief, Reservoir Regulation Section	HU-2-8100* (Ext. 171)	Wellesley 5-0899M
Robert S. Restall	Reservoir Regulation Section	"	Mansfield 375R
F. C. Merrikin	"	"	None
A. M. Harriman	"	"	Waltham 5-6588M

*Night Telephone - HU-2-8106

(4) Scope of Report. - Insofar as possible the

following information relative to both reservoirs should be included in the report to the Reservoir Regulation Section.

(a) The total amount of precipitation which has fallen up to the time of reporting and several intermediate amounts with the time of observation.

(b) The pool elevation at the time of reporting, and several previous readings with the corresponding time to define the hydrograph or rate of rise of the pool. Accurate, simultaneous readings of both stage and time are very essential to facilitate computations by the Section.

(c) Gate openings and discharges at the time of reporting and at the beginning of the storm.

(d) Reports of precipitation received from other sources.

(e) River stages at the key damage control points. (Plate No. 7)

(f) General snow cover and runoff conditions throughout the basin.

(g) Any other information which might be of assistance in operating the reservoir.

(5) Operation of Both Reservoirs. - (a) General. - The reservoirs will be operated by closing the outlet gates, either partially or completely, to store flood waters within the reservoir in order to prevent damage in the downstream communities. It should be emphasized, if flood damage is imminent, that it is preferable

to operate prematurely and perhaps unnecessarily than to delay gate operation until real damage has been caused. It is also essential during the development period of a flood to maintain the stage of the Millers River a foot or two below critical channel capacity to allow for unexpected variations in local flows, uncertainties in channel capacity, and minor inaccuracies in the computed stage-discharge curves.

Surcharge storage above the elevation of spillway crests may be utilized during a major flood if the downstream channel capacity continues to be exceeded by the runoff from uncontrolled areas. In general, gates will not be opened to avoid spillway discharge if damage would result from such action. However, considerable judgment may be necessary for operating Birch Hill during such an occurrence, for the damage caused by higher surcharge elevations in Baldwinville will require comparison with downstream damages to determine the method of operation.

(b) Local Floods on Millers River. - During local floods, the stage of Millers River will be maintained at, or below, the point of real damage at the key control points (Plate No. 7). During minor floods not requiring complete closure of outlet gates, the amount of water to be stored in each reservoir will be in proportion to their available capacities in inches of runoff. During a major flood, gates will be completely closed in both dams irrespective of storage allocations if such operation is necessary to reduce the downstream flows as much as possible.

(c) Floods on the Connecticut River. - Floods

may occur on the Connecticut River without causing more than a minor rise on the Millers River. Under such conditions the gates of both dams will be operated to minimize the contribution from the Millers River to the Connecticut River flood. Only sufficient flow will be released to satisfy the downstream water users along Millers River. When only partial gate closure is required, the discharge from each dam will be governed by the proportion of storage capacity in inches of runoff available below spillway crest of each dam (Plate Nos. 11 and 15). This regulation of flow will be continued until the flood peak of the Connecticut River has passed Springfield, and the river at Montague City has receded to the flood stage of 28.0 feet.

(d) General Floods. - During general comprehensive floods extending over both the Connecticut and Millers River Basins, Birch Hill and Tully Reservoirs will be operated generally as described in the preceding paragraphs (5) (b) and (5) (c). A general storm will produce flood flows on the Millers River before the flood develops on the Connecticut River and the initial reservoir operation will be governed by conditions on the Millers River. Following the subsidence of the flood on the Millers River, discharge regulation will be continued until the flood has also receded on the Connecticut River as previously described.

(e) Emptying the Reservoir. - Following the recession of the flood, the reservoirs will be emptied as rapidly

as possible without exceeding the safe downstream channel capacity. Ordinarily, the river stages will be maintained below nuisance damage during the emptying period. Increasing the discharges to produce stages causing real damage will be done only on instructions from the Reservoir Regulation Section. A balance of available capacity for storage should be maintained between the two reservoirs. The reservoir with the least available capacity for storage should have a higher emptying rate consistent with safe channel capacities until the available storage in inches in both reservoirs is approximately the same. For example, with 1,000 c.f.s. allowable outflow and 5.0 inches of storage utilized at both Tully and Birch Hill, the available remaining storage capacities at Tully and Birch Hill are 3.3" and 0.3", respectively. Since Birch Hill has less available capacity than Tully, there should be no discharge from Tully, and the entire discharge of 1,000 c.f.s. should come from Birch Hill until the available storages are approximately equal. Then the reservoirs should be emptied with the discharge contribution proportional to the respective drainage areas, with the result that about $3/4$ of the flow will come from Birch Hill and $1/4$ of the flow from Tully.

In releasing the water from storage, it is desirable to operate the gates to produce a uniform distribution of flow in the tailwater discharge channel. At Birch Hill Dam where four gates are involved, it is believed preferable to operate the two outside gates up to a full opening with the two inside gates being used when an increased discharge area is required. At Tully

Dam this objective may be effected in the case of two gates by operating each gate at partial openings. However, if it is found that certain circumstances cause objectionable downstream turbulence, or vibration of the gates, the arrangement of the gates should be altered to eliminate these conditions. For gate rating curves for Birch Hill, see Plate Nos. 12 and 13, and for Tully, see Plate Nos. 16 and 17.

(f) Operations if Communications Fail. - If the damtender is unable to communicate with the Reservoir Regulation Section and it appears necessary to act promptly, the Birch Hill damtender will operate the Birch Hill gates and instruct the Tully damtender in his operation in accordance with instructions as previously described under paragraph 3. However, possession of the instructions contained in this manual does not relieve the damtender of his responsibility for continued efforts to communicate with the Division Office. Upon resumption of communications, the operation of the reservoirs will be directed by the Reservoir Regulation Section.

4. Reports.

a. Normal Operation. - (1) General. - A report of reservoir operations and hydrologic conditions will be submitted weekly and monthly as required. The weekly report should include recorder charts of the pool elevation gage, rainfall records, gate operation record, and the Birch Hill weekly rainfall report card. The monthly report for Birch Hill will also include the chart for the U. S. G. S. Gaging Station in South Royalston, and the Tully monthly

report will include the chart from the tailwater gage. The weekly report should be sent each Monday and the monthly report on the first day of the month.

(2) Reservoir Stage. - The automatic water level recorder records the water surface in the reservoir at all times except when the pool stage is lower than the intake to the float well. The recorder hydrograph should be checked each morning to see that the clock is keeping correct time and that the pen is inking properly. Also, if there are any discrepancies in the pen time or gage height, they should be noted on the chart. In the case of the pool gage being lower than the intake to the float well, the gage reading should be plotted on the chart together with the time of observation. It is preferable that this be done at about the same time each day.

The chart should be changed once a week and on the first of each month. At the beginning and ending of each chart the following information should be noted in ink: (a) outside gage reading, (b) pen gage reading, (c) watch time, and (d) pen time.

(3) Gate Operation Record. - All gate operation should be carefully noted on NED Form 91, 3 March 1947, and inclosed with recorder charts of reservoir stages in the weekly and monthly reports. All operation should be noted regardless of duration of the change in gate position. The report should include date and time of day, gate opening, reservoir gage height, and reason for operation.

(4) Tailwater Gage. - The operator of Tully Dam will check the U. S. G. S. gage in the outlet channel daily to be sure it is in good working order, note gage heights and time on it, and that the indicator in the gate house and the recorder are alike. On the first of every month, the damtender should remove that portion of the chart which contains the gage record, label the old and new charts with inside tape, outside gage, pen gage heights, watch time, and time of removal and include the chart in the monthly report.

(5) Rainfall Data. - The operators at Birch Hill and Tully should read the rain gage daily. If less than 1/4" of precipitation has fallen, the pen of the recording gage should be raised to the next heavy line to prevent overlapping records. The operator should check that the clock is running correctly and the pen is inking properly. The chart should be changed each Monday for the weekly report and the first day of each month for the monthly report. The monthly climatological report should be made out according to weather bureau instructions on each pad and included with the monthly report. The weekly report card submitted with the recording rain gage chart is used principally to determine times of beginning and ending and types of precipitation. The method of recording is similar to the monthly report.

(6) Snow Courses. - The locations of the courses are shown on Plate No. 2. The amounts of snow cover will be measured during the late winter and early spring months. Exact dates

will be determined each year to coordinate with the published report of the U. S. Geological Survey.

b. Flood Control Operation. - (1) General. - As soon as practical after a reservoir has been operated for flood control, a report will be submitted to the Reservoir Regulation Section describing the subjects outlined in the following paragraphs. The report may be written in longhand and forwarded to the Division Office.

(2) Observations at the Dam. - The damtenders should make general observations of conditions occurring at the inlet and outlet works, as listed below:

(a) Extent and action of eddies and waves along the spillway and outlet approach channel walls.

(b) Extent and action of turbulence downstream of the spillway and outlet works.

(c) Effect on the flow through the gates due to an accumulation of ice or debris on the trash racks.

(d) The pool elevation and position of the gate opening at which vibration occurs.

(e) Any other hydraulic phenomena that may occur. Some of the above conditions can best be shown by photograph together with information on the date, time, and the elevation of the pool.

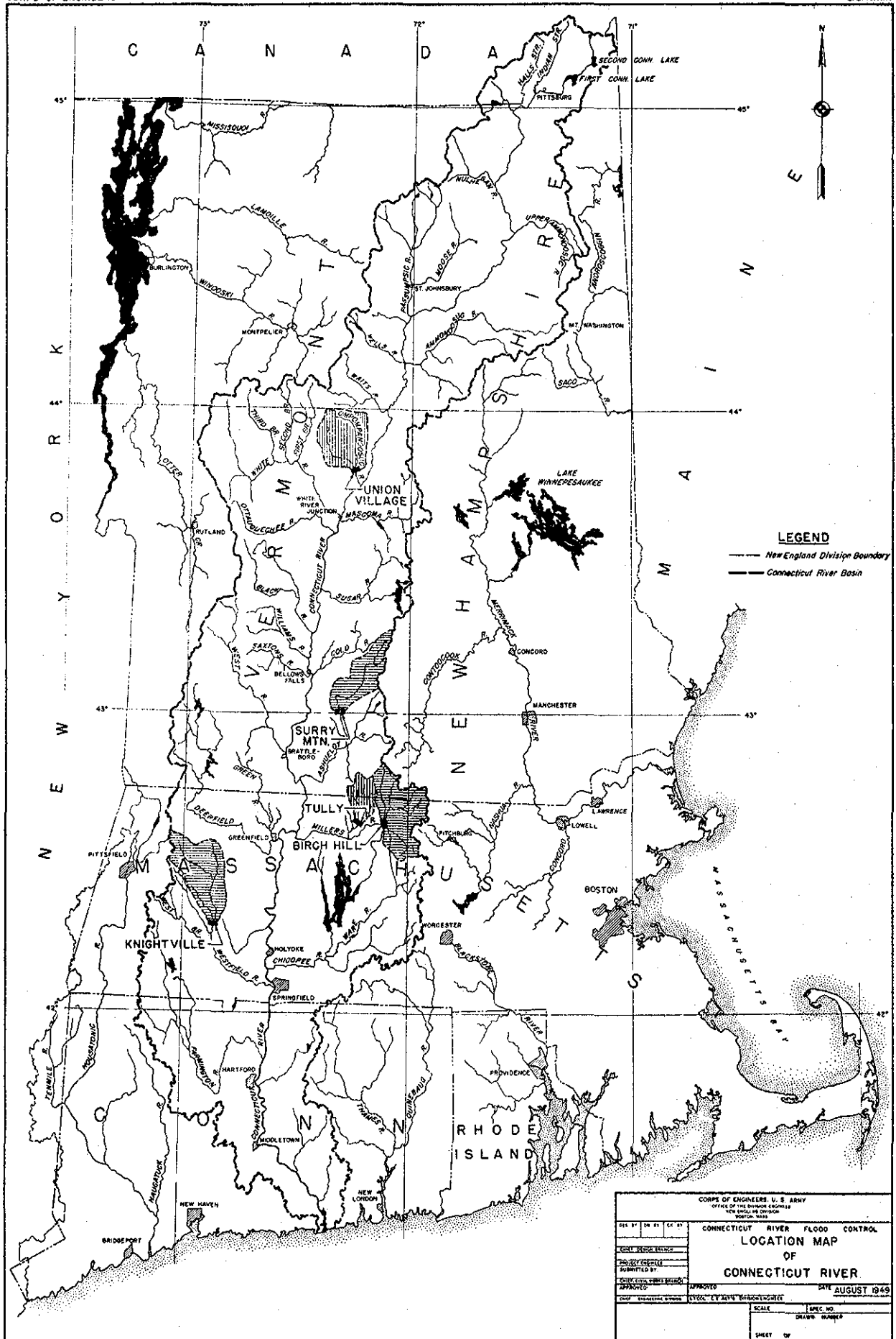
(3) Observations at the Key Damage Control Points. - General observations along the Millers River in view of substantiating

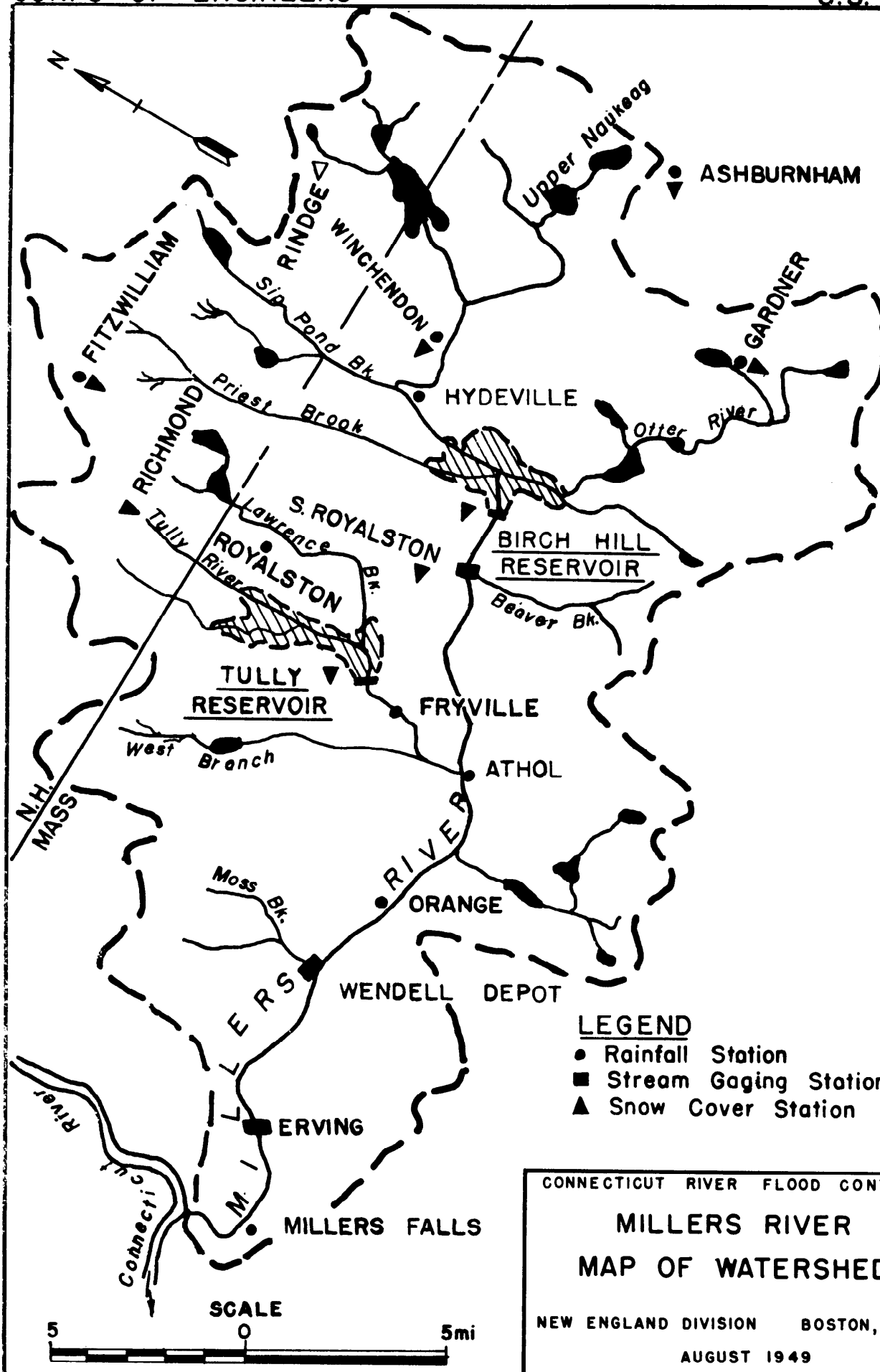
the accuracy of the range from nuisance damage to real damage at the key control points as shown on Plate No. 7.

(4) Resume of Operations. - A brief chronological record (diary) of all operations pertaining to the operation of the reservoir, together with date, time and remarks.

Example

<u>Date</u>	<u>Time</u>	<u>Remarks</u>
10 Mar. 50	10:00 A.M.	Rec'd call from Chase Turbine Co., gage reading of 1.5' and rising.
	10:15 A.M.	Pool elev. 822 and rising 1 ft. per hour.
	10:20 A.M.	Called Division Office for action to be taken. Instructed by Childs to close gate No. 1.
	10:45 A.M.	Bad cross-eddy in discharge channel caused by closing gate No. 1 - closed gate 3 and opened No. 1 - eddy eliminated.
		etc.







SCALE: 1 IN. = 8 MI.











SCALE: 1 IN. = 500 FT.



DRAINAGE AREA 155 SQ.M.



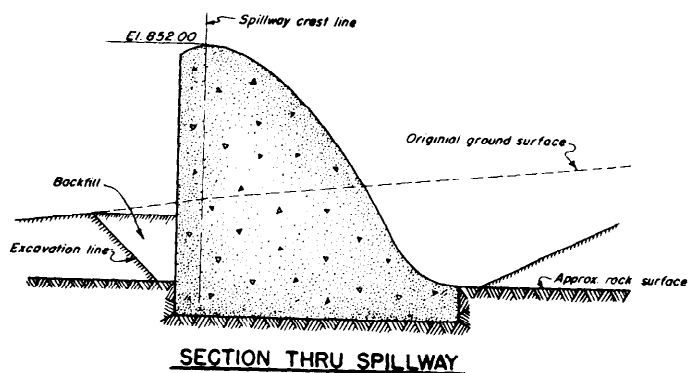
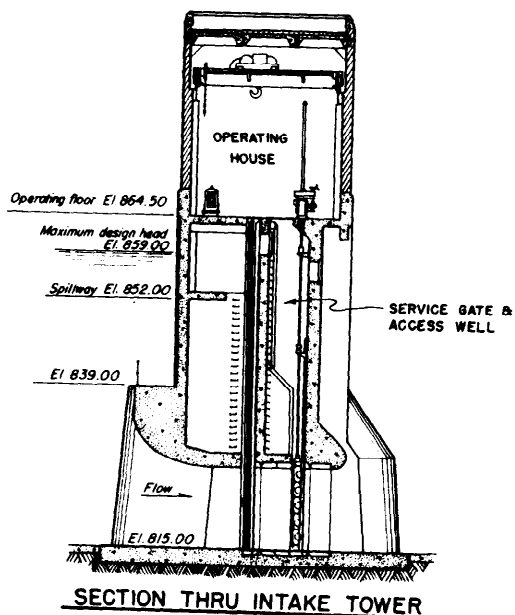
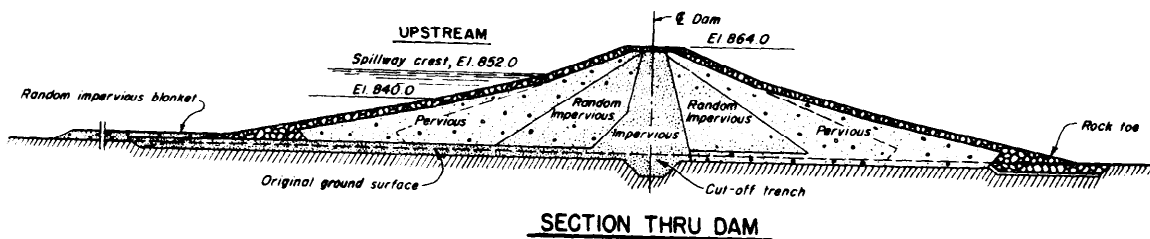
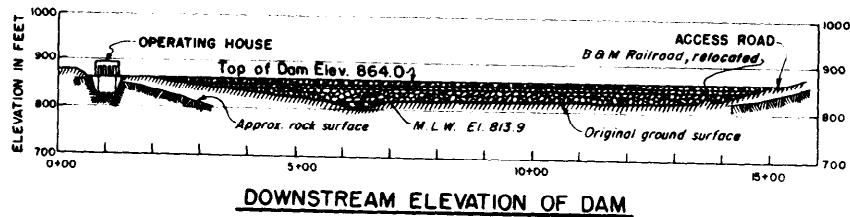
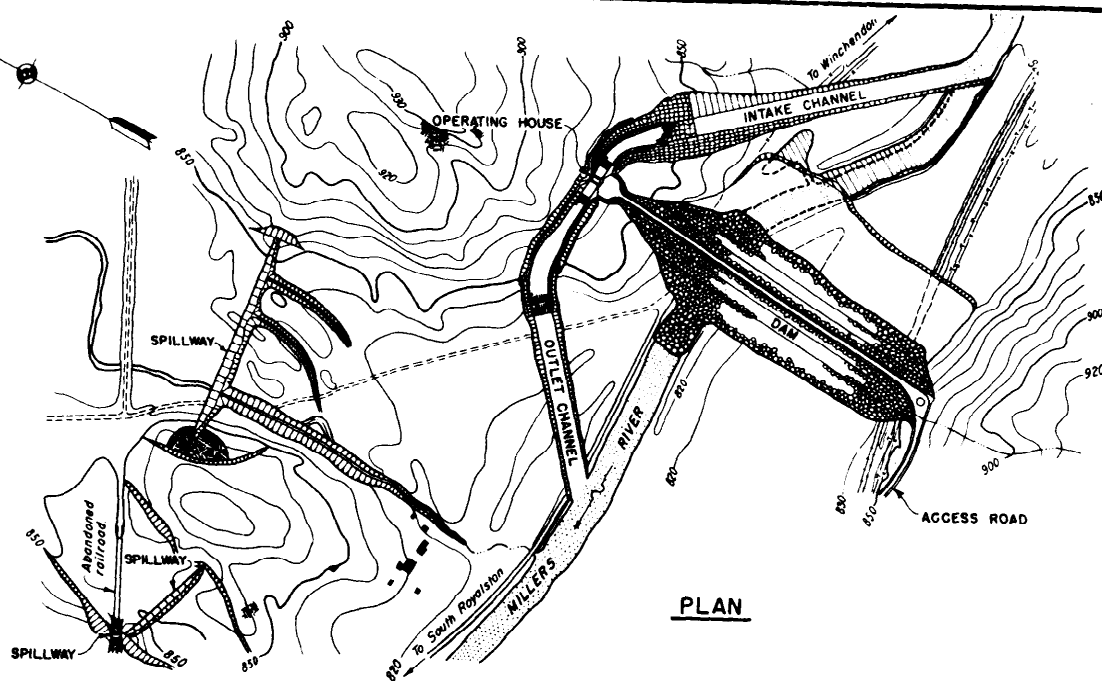
- | | |
|---|--|
|  | <i>Existing numbered routes.</i> |
|  | <i>Existing paved highways.</i> |
|  | <i>Existing gravel roads.</i> |
|  | <i>Proposed highway relocation or improvement.</i> |
|  | <i>Existing railroad location.</i> |
|  | <i>Proposed railroad relocation or improvement.</i> |
|  | <i>Reservoir flowage area at spillway crest. El. 852.0</i> |
|  | <i>Proposed power line relocation.</i> |

CONNECTICUT RIVER FLOOD CONTROL
BIRCH HILL DAM
RESERVOIR MAP

MILLERS RIVER
IN 1 SHEET SHEET NO. 1
NEW ENGLAND DIVISION, BOSTON, MASS. MASSACHUSETTS
SCALE: 1 IN. = 1000 FT. FEB 1947

APPROVAL RECOMMENDED <i>John A. Allen</i> DIST. INFORMATION DIVISION SUBMITTED -21-8-66	APPROVED <i>R. J. Hunt</i> COL. CORPS OF ENGINEERS ASST. TO DIVISION ENGINEER
---	--

PROJECT NO.	FILE NO.
CT-1-2137	CT-1-2137



CONNECTICUT RIVER FLOOD CONTROL PROJECTS

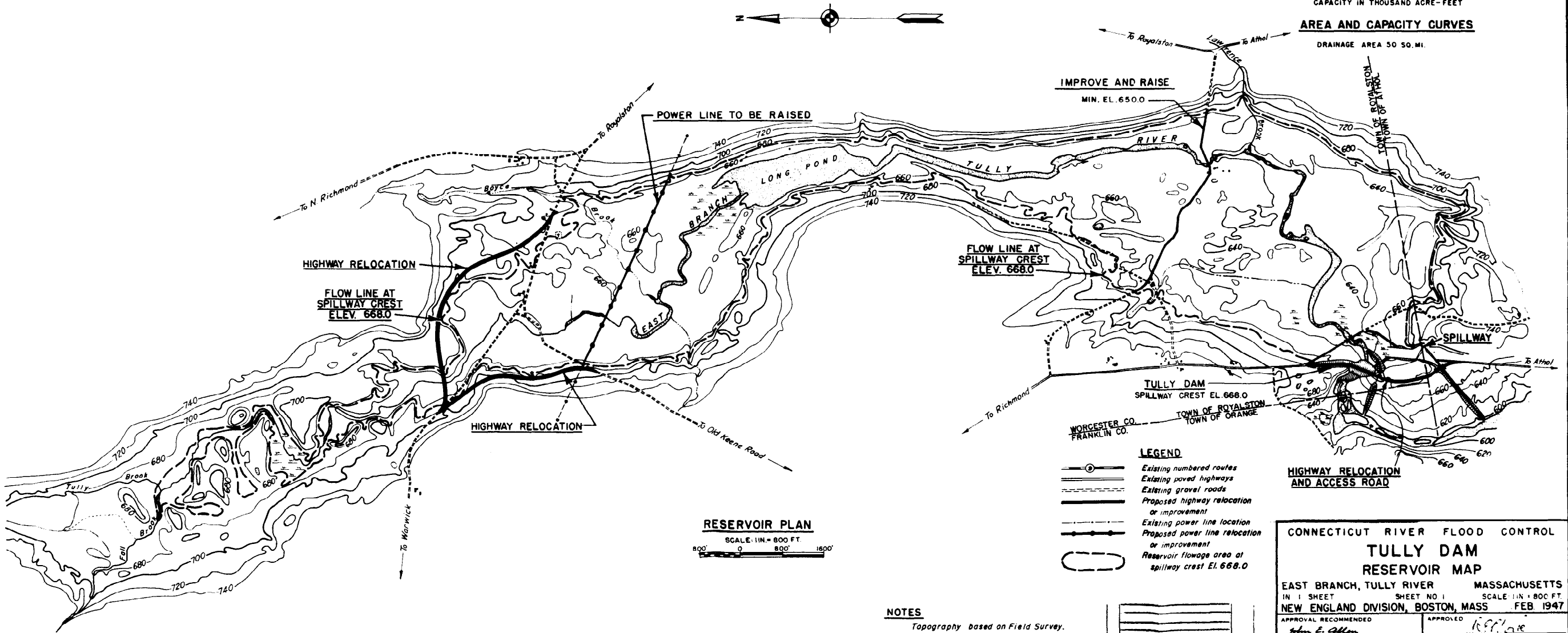
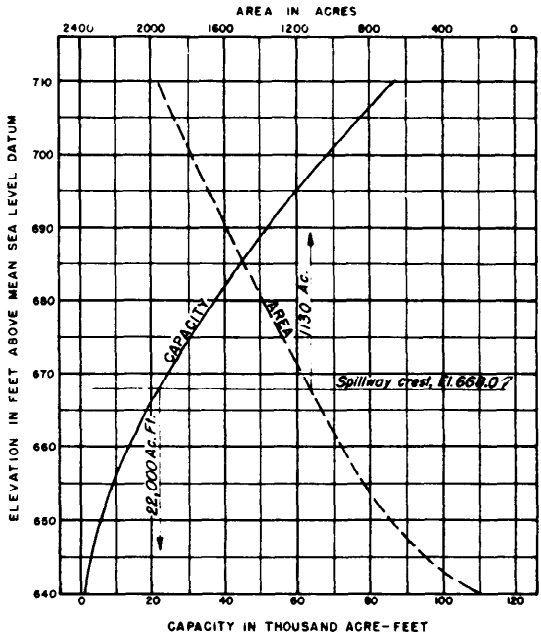
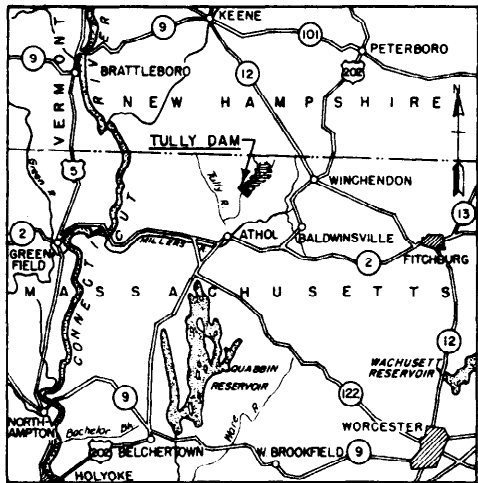
BIRCH HILL DAM PLAN AND SECTIONS

JUNE 30, 1949

MILLERS RIVER
IN 2 SHEETSMASSACHUSETTS
SHEET NO. 2

NOT TO SCALE

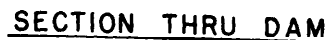
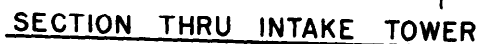
NEW ENGLAND DIVISION, BOSTON, MASS.



CONNECTICUT RIVER FLOOD CONTROL	
TULLY DAM	
RESERVOIR MAP	
EAST BRANCH, TULLY RIVER	MASSACHUSETTS
IN 1 SHEET	SHEET NO. 1
NEW ENGLAND DIVISION, BOSTON, MASS	FEB 1947
APPROVAL RECOMMENDED	APPROVED
SUBMITTED	ASST TO DIVISION ENGINEER
PROJECT NO.	FILE NO CT-1-2140

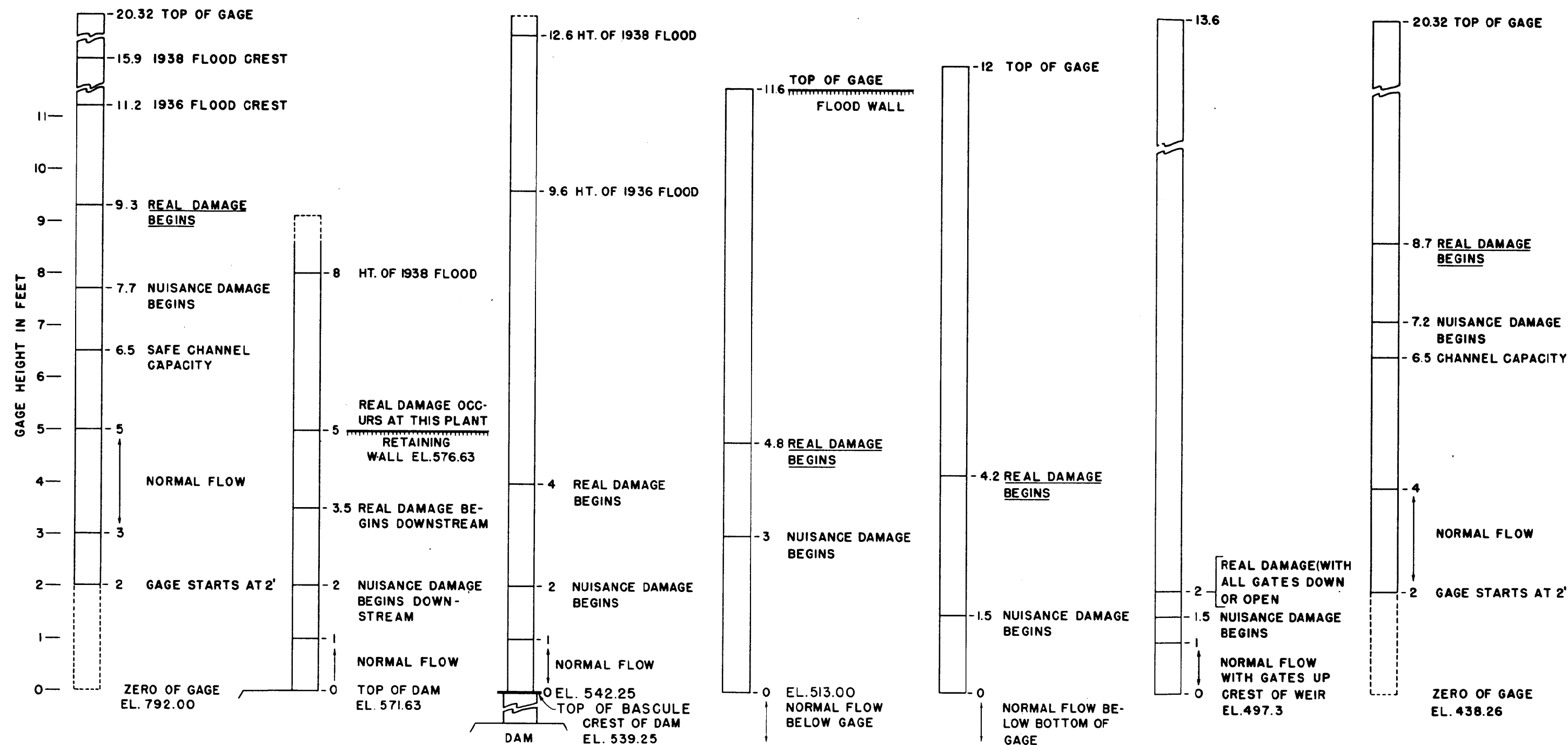


PLAN



SHEET NO. 2

NEW ENGLAND DIVISION, BOSTON, MASS.



U. S. G. S. GAGE AT
SOUTH ROYALSTON

ATHOL MFG. CO.
ATHOL, MASS.

TEL : ATHOL 330
DAM : CONC. OVERFLOW
260 FT. LONG

L. S. STARRETT CO.
ATHOL, MASS.

TEL : ATHOL 6
WEIR : BASCULE 3FT. HIGH
DAM : CONC. OVERFLOW
98 FT. LONG

EXCHANGE ST BRIDGE
ATHOL, MASS.

TEL : ATHOL 197

MAIN ST BRIDGE
ATHOL, MASS.

TEL : ATHOL 197

CHASE TURBINE CO.
ORANGE, MASS.

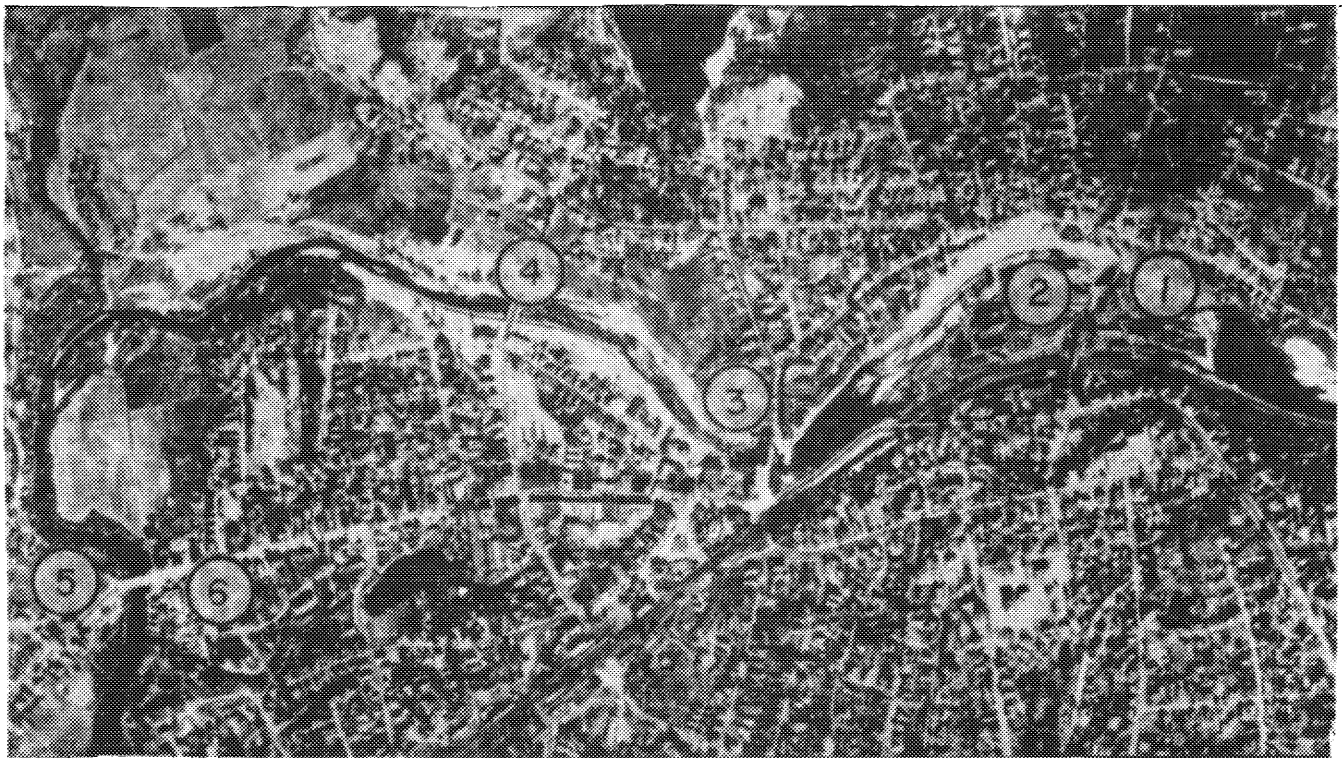
TEL : ORANGE 20
WEIR : BASCULE 4FT. HIGH
DAM : CONC. OVERFLOW
87 FT. LONG

U. S. G. S. GAGE AT ERVING

CONNECTICUT RIVER FLOOD CONTROL
MILLERS RIVER
KEY DAMAGE CONTROL POINTS

NEW ENGLAND DIVISION BOSTON MASS

AUGUST 1949



ATHOL

POINT NO	CONTROL POINT	DAMAGE STAGE	1938 FLOOD CREST	REFERENCE ELEVATION
1	Athol Mfg. Co.	5.0	8.0	Top of Dam Zero of Staff Gage El. 571.63
2	Union Twist Drill Co.	3.5	8.0	Top of Dam Athol Mfg. Co. Staff Gage
3	L.S. Starrett Co.	4.0	12.6	Top of Bascule Zero of Staff Gage El. 542.25
4	Exchange St. Bridge	4.8	15.5	Zero of Staff Gage El. 513.00
5	Main St. Bridge	4.2	12.0	Zero of Staff Gage
6	Cass Toy Co.	4.0	12.0	Main St. Staff Gage

CONNECTICUT RIVER FLOOD CONTROL

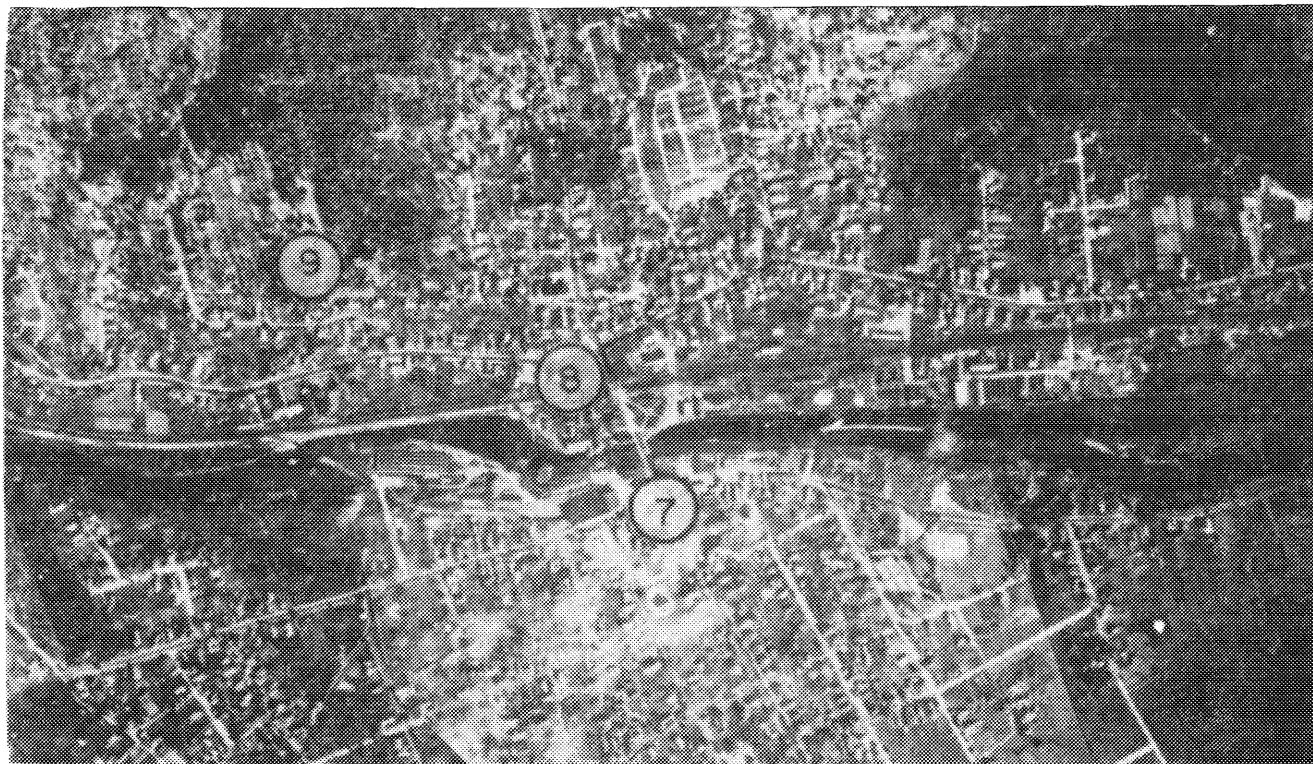
ATHOL

DAMAGE CONTROL POINTS

NEW ENGLAND DIVISION BOSTON, MASS

AUGUST 1949

PLATE NO. 8



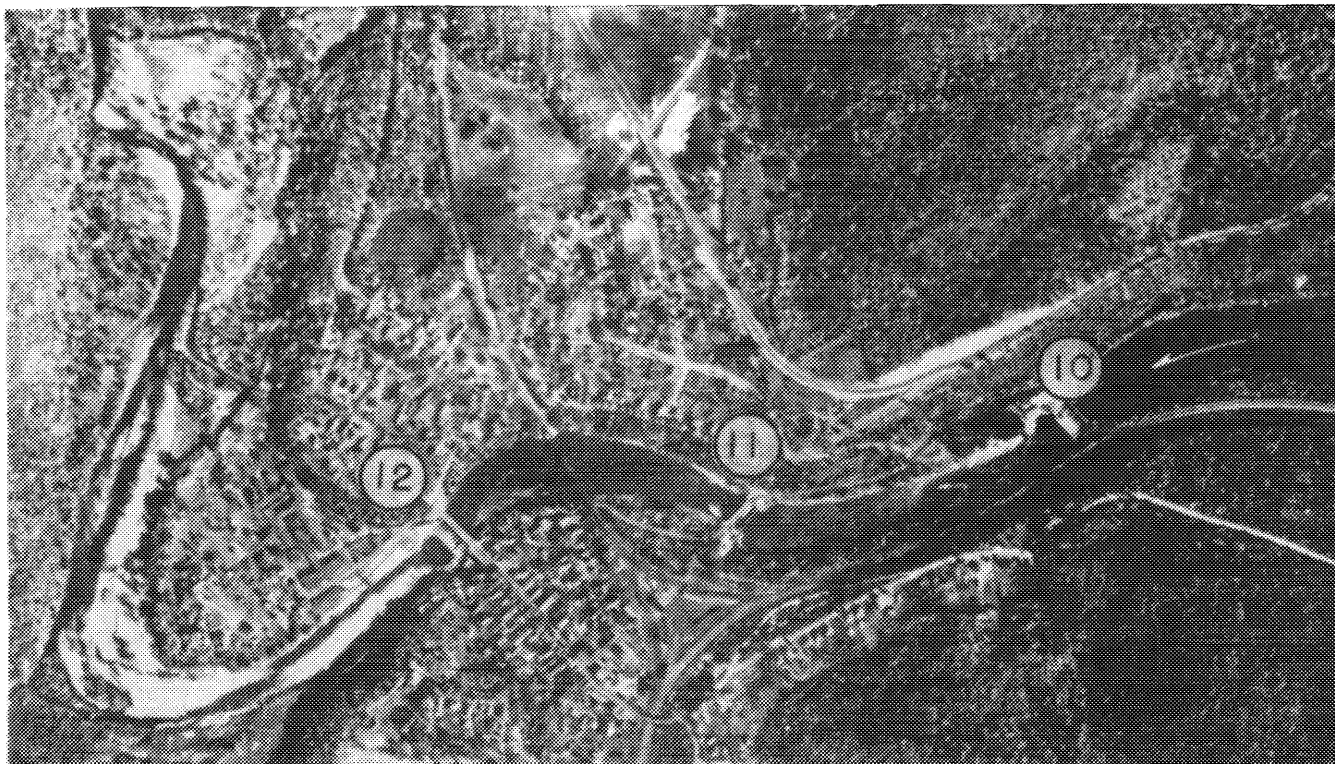
ORANGE

POINT NO	CONTROL POINT	DAMAGE STAGE	1938 FLOOD CREST	REFERENCE ELEVATION
7	Main St. Bridge	1.5	13.6	Staffgage at Main St. Bridge
8	Chase Turbine Co.	2.0	13.6	Staffgage at Main St. Bridge
9	Minute Tapioca Co.	5.0	13.6	Staffgage at Main St. Bridge

CONNECTICUT RIVER FLOOD CONTROL
 ORANGE
 DAMAGE CONTROL POINTS
 NEW ENGLAND DIVISION BOSTON MASS

AUGUST 1949

PLATE NO. 9



MILLERS FALLS

POINT NO	CONTROL POINT	DAMAGE STAGE	1938 FLOOD CREST	REFERENCE ELEVATION
10	Millers Falls Paper Co.	4.0	11.8	Crest of dam - El. 271.7
11	Millers Falls Paper Co.	4.0	14.4	Crest of dam - El. 243.6
12	Millers Falls Tool Co.	6.0	13.1	Crest of dam - El. 229.8

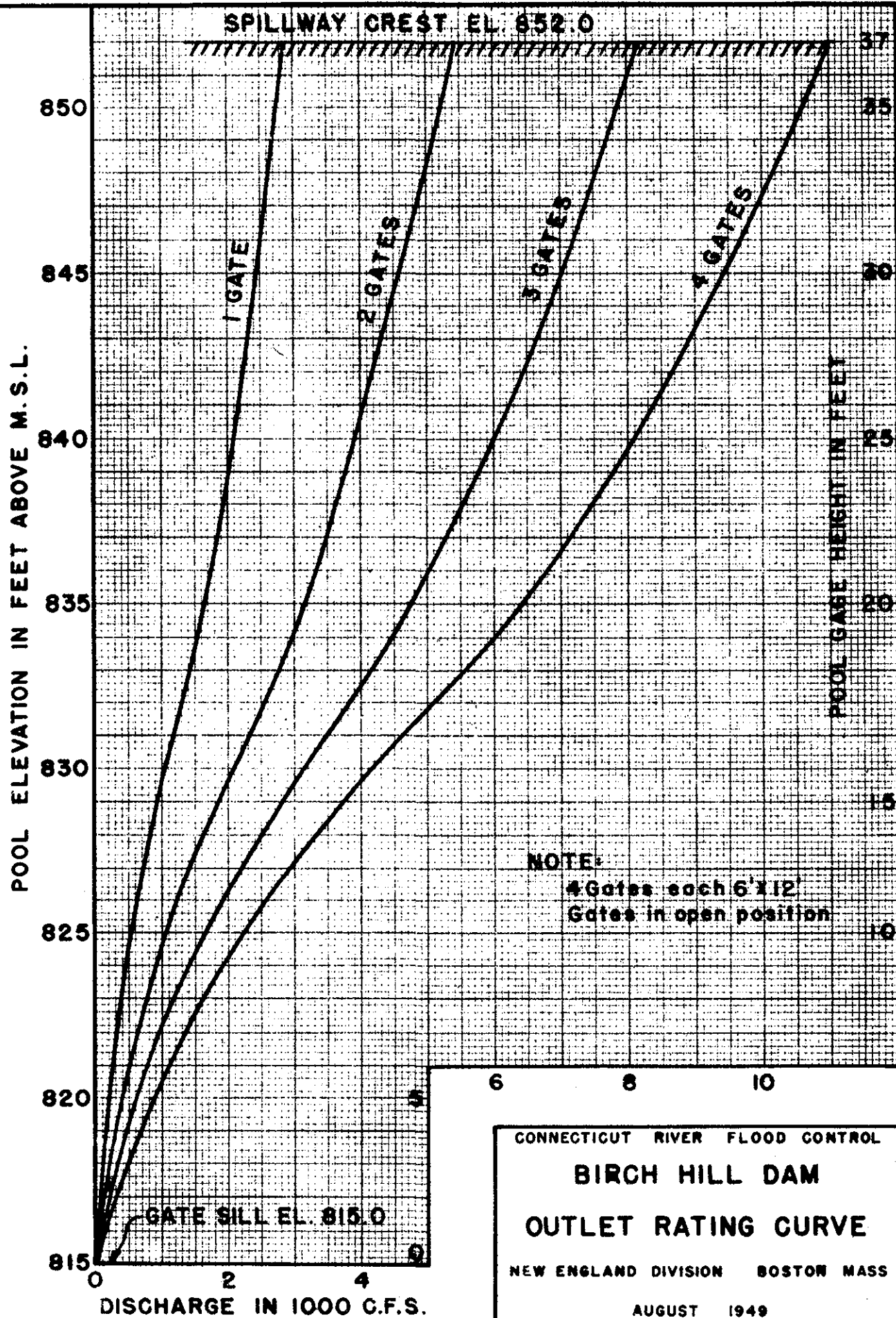
CONNECTICUT RIVER FLOOD CONTROL

**MILLERS FALLS
DAMAGE CONTROL POINTS**

NEW ENGLAND DIVISION BOSTON, MASS

AUGUST 1949

PLATE NO. 10



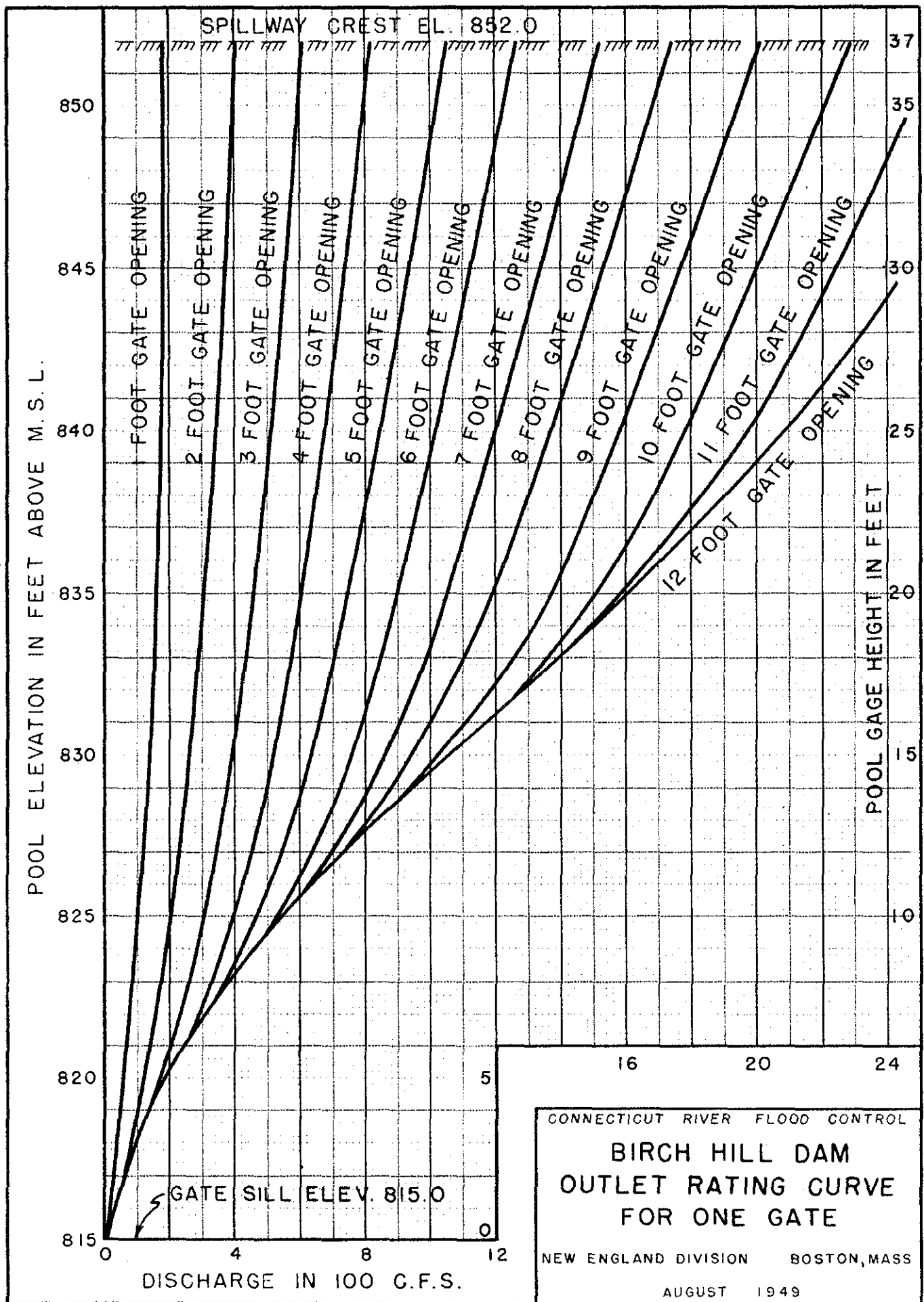
CONNECTICUT RIVER FLOOD CONTROL

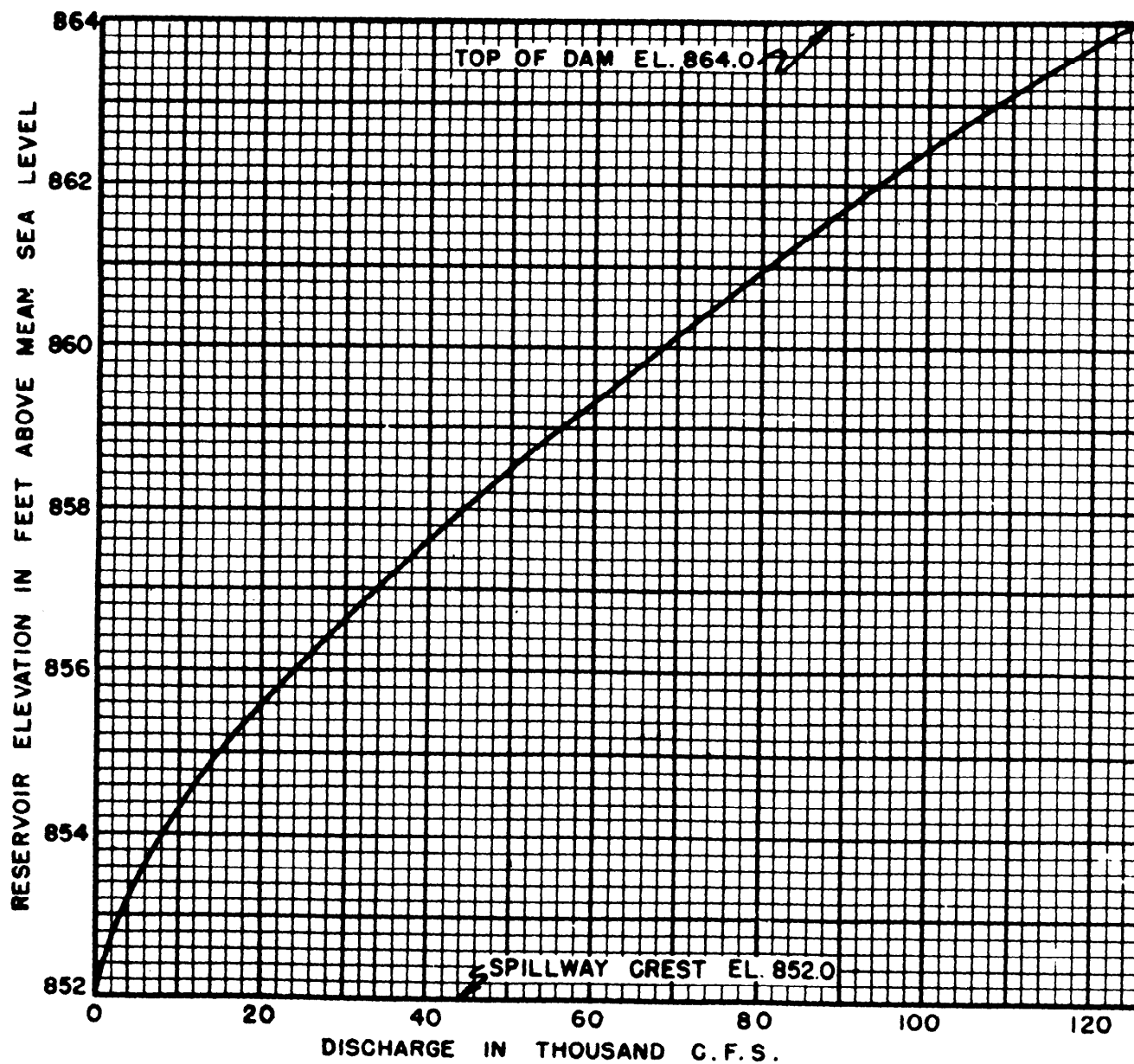
BIRCH HILL DAM

OUTLET RATING CURVE

NEW ENGLAND DIVISION BOSTON MASS

AUGUST 1949



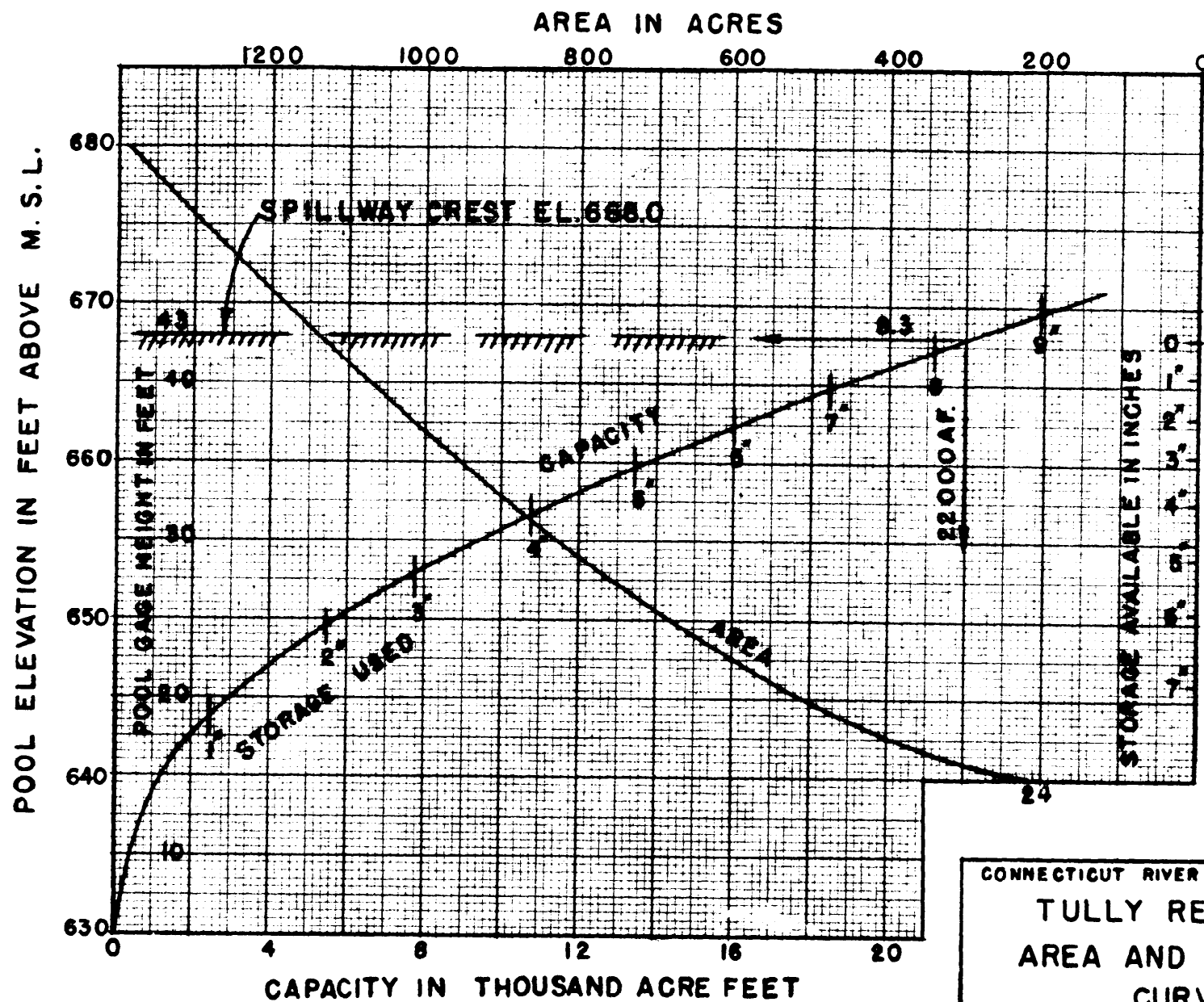


NOTE: Weir No.1---- 720'
 No.2---- 350'
 No.3---- 23'
 Total Length 1,093'

CONNECTICUT RIVER FLOOD CONTROL
BIRCH HILL DAM
SPILLWAY RATING CURVE
 NEW ENGLAND DIVISION BOSTON MASS

AUGUST 1949

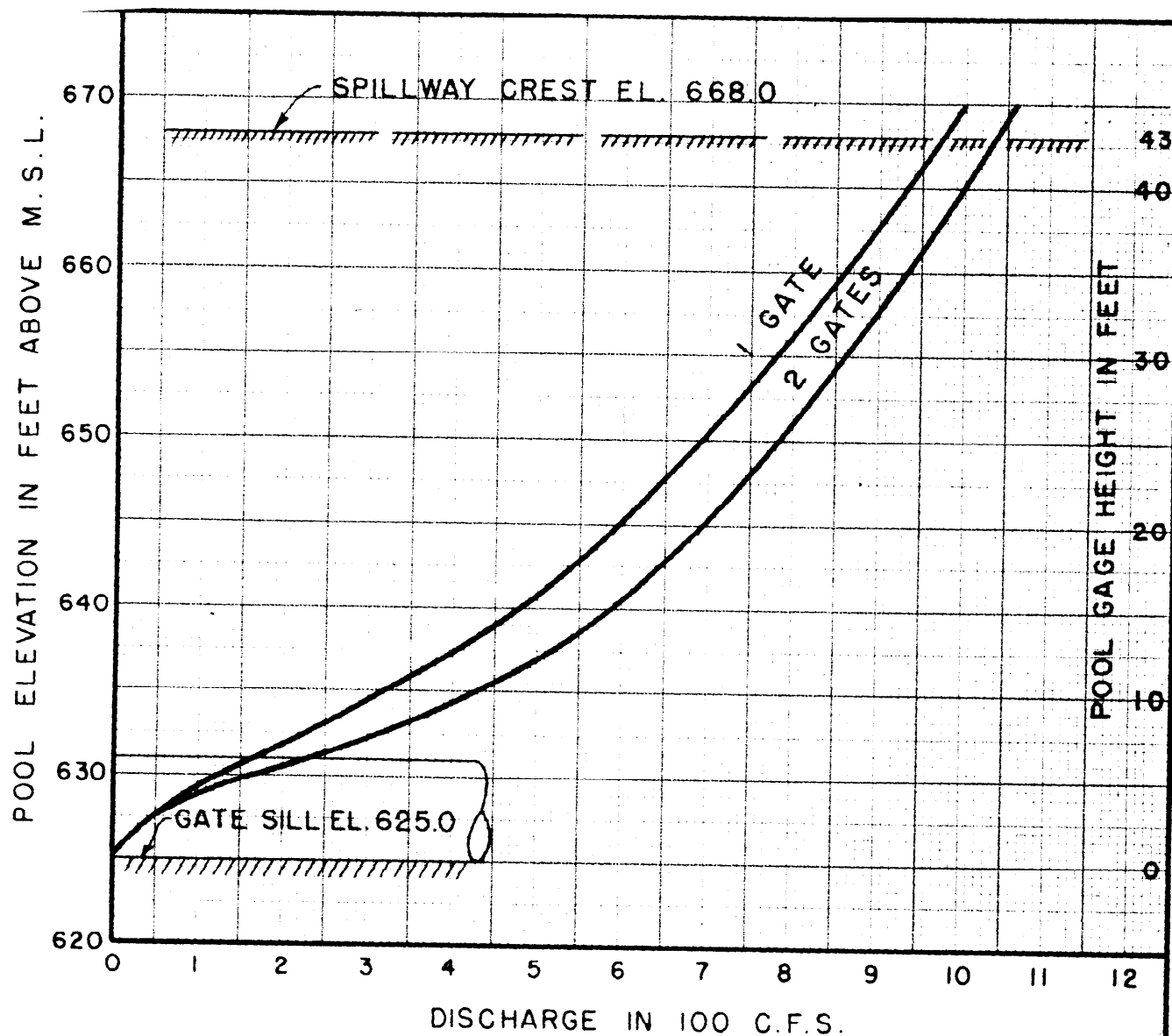
PLATE NO.14



CONNECTICUT RIVER FLOOD CONTROL
TULLY RESERVOIR
AREA AND CAPACITY
CURVES

NEW ENGLAND DIVISION BOSTON, MASS.

AUGUST 1949



NOTE:

2 Gates - each 3.5' x 6.0'
Gates in open position

CONNECTICUT RIVER FLOOD CONTROL

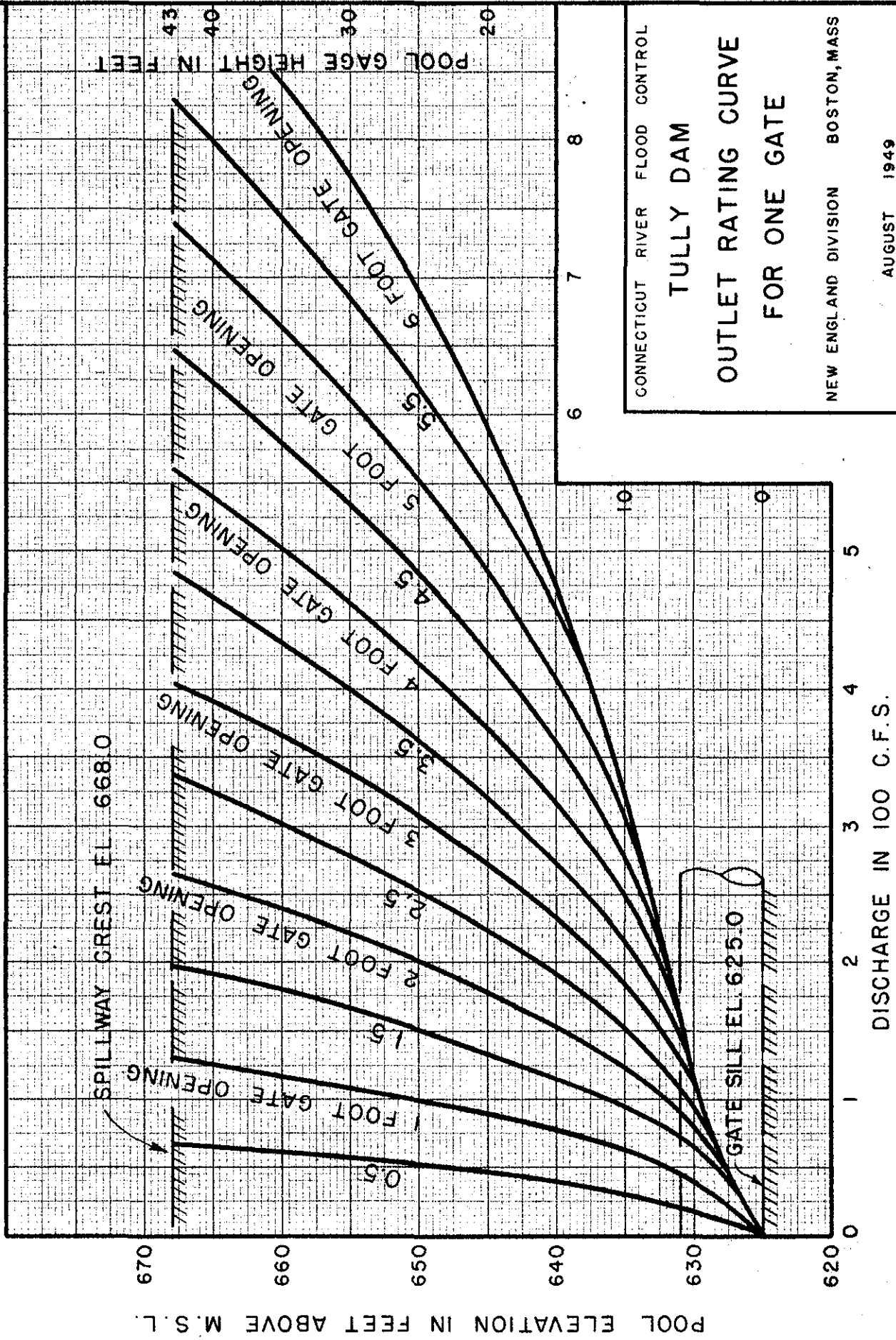
TULLY DAM

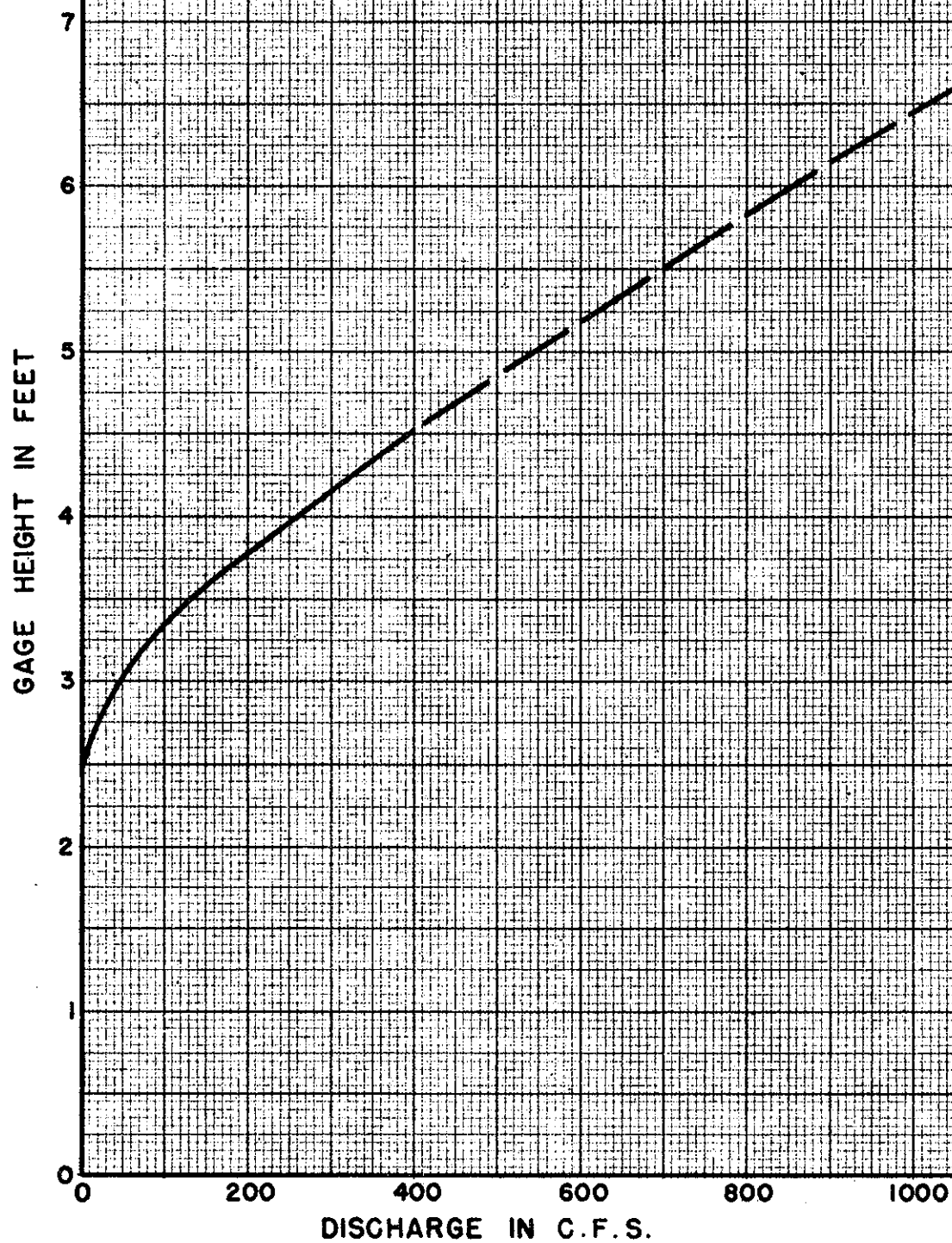
OUTLET RATING CURVE

NEW ENGLAND DIVISION BOSTON, MASS

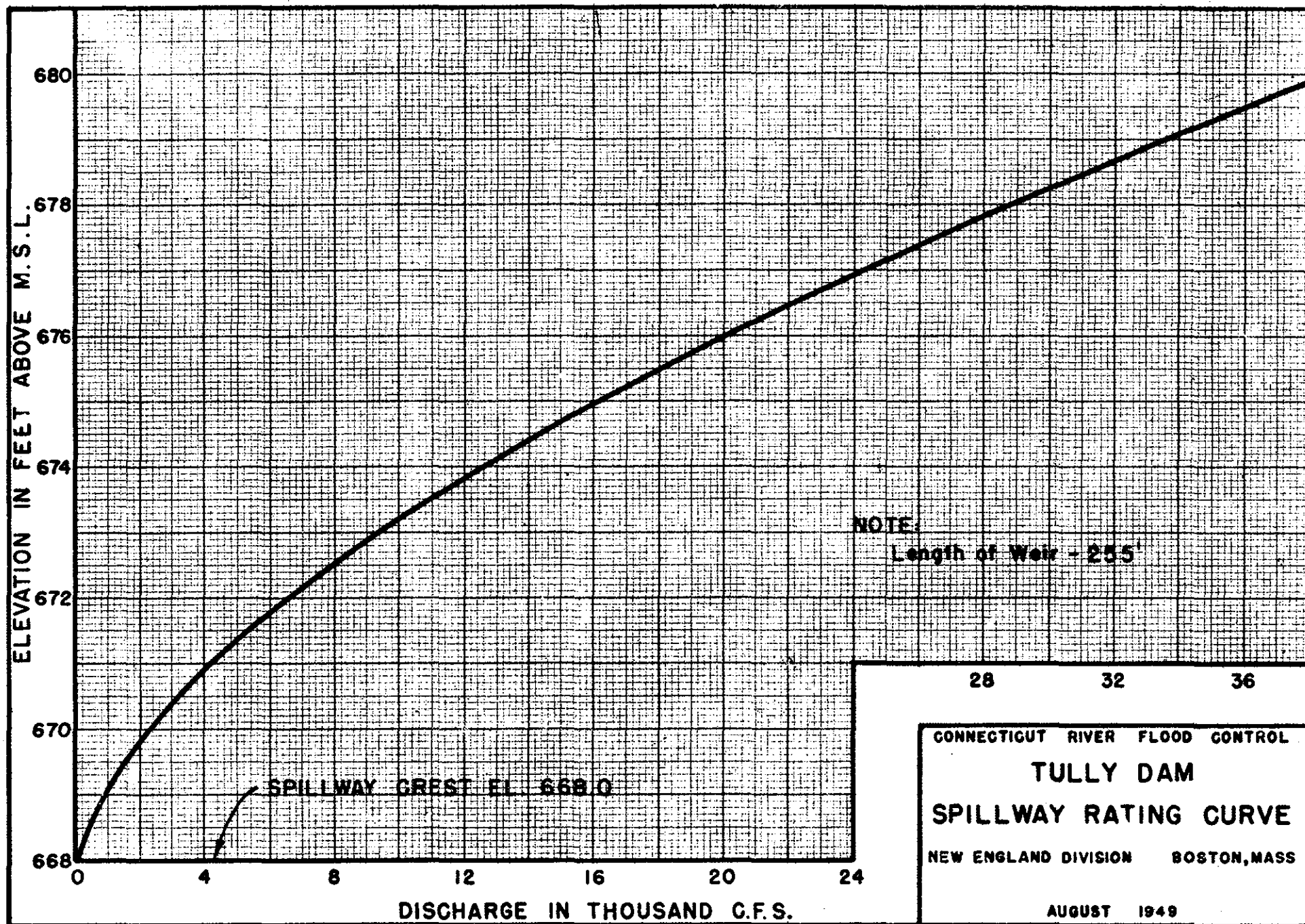
AUGUST 1949

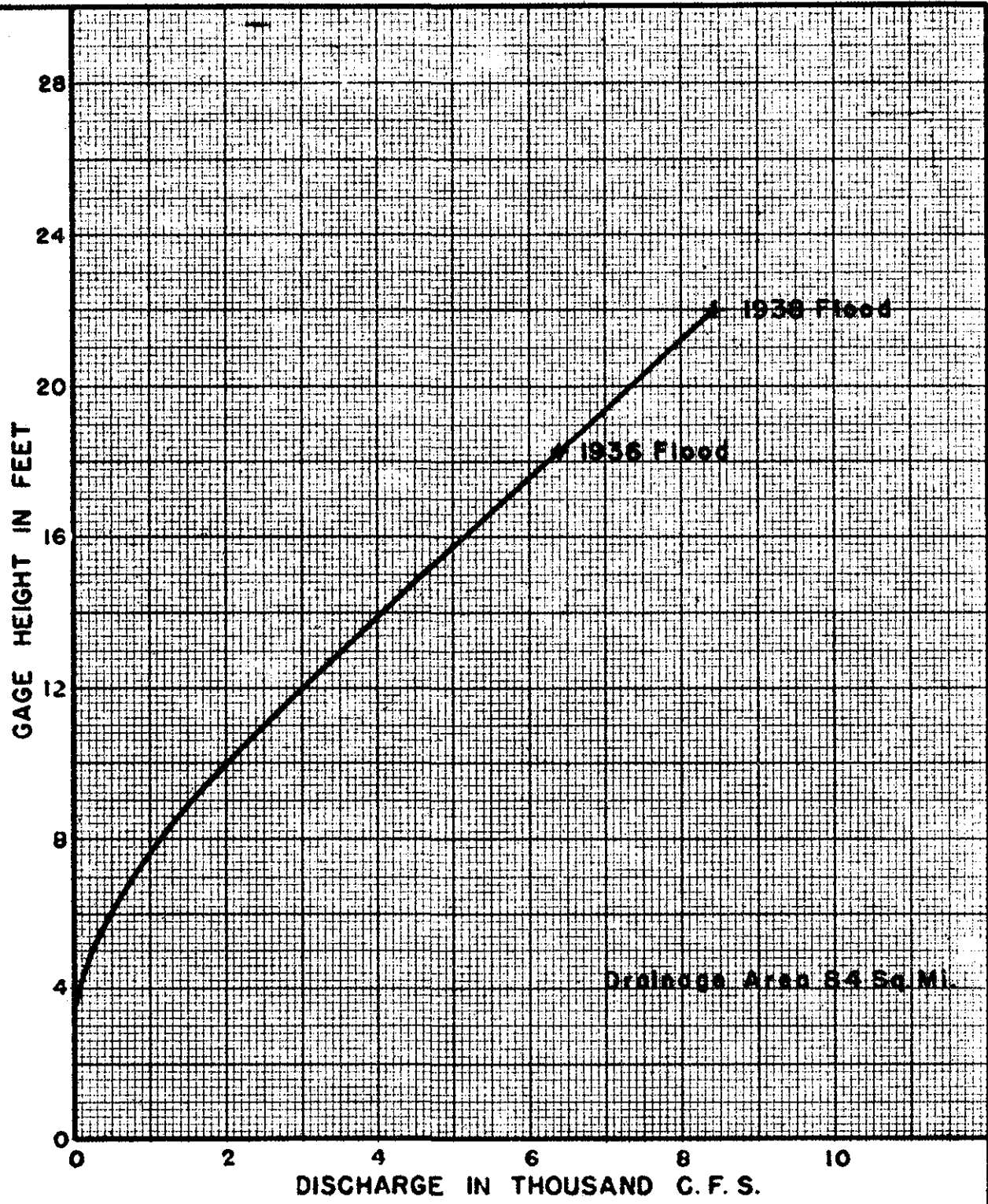
PLATE NO. 16



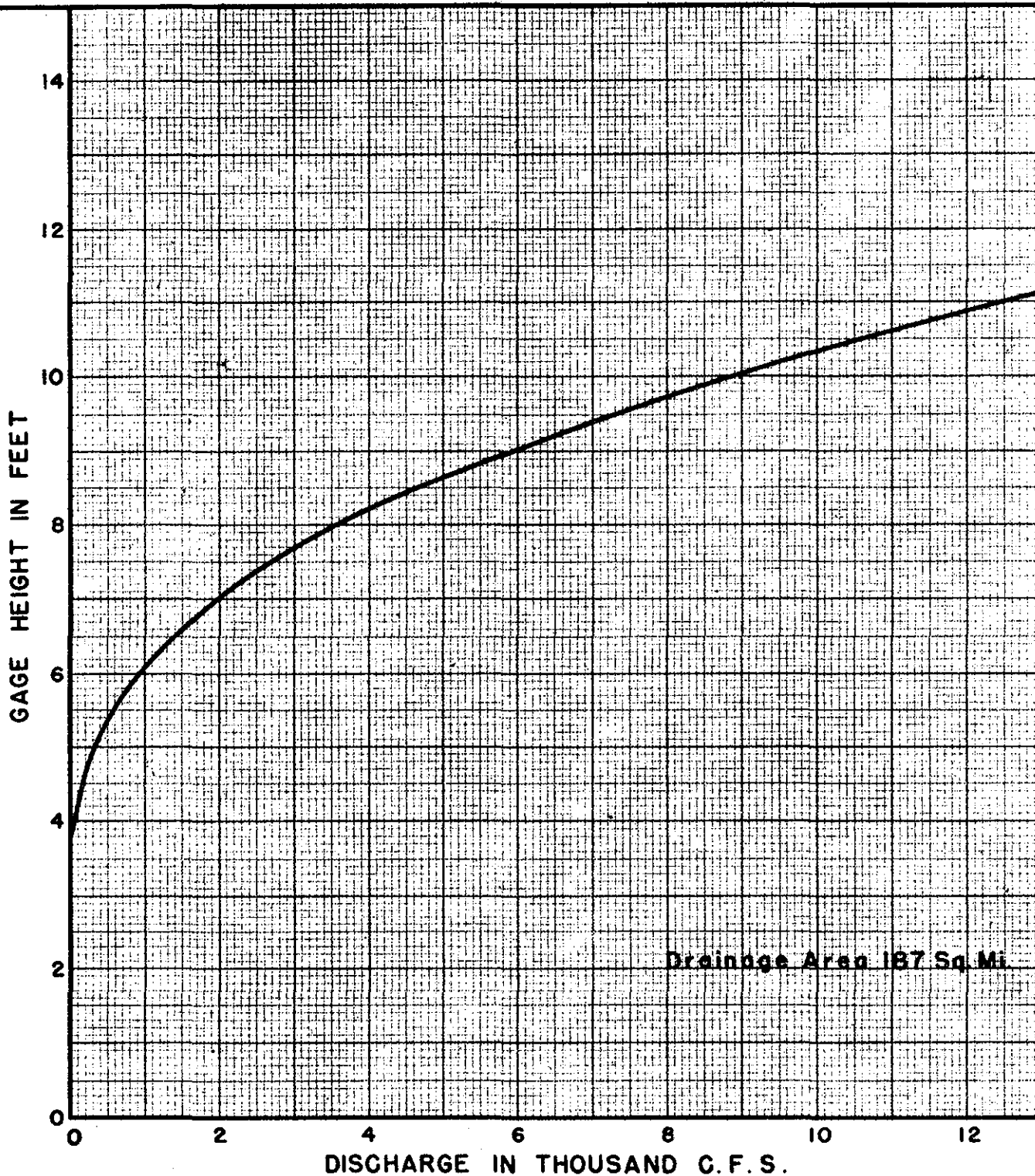


CONNECTICUT RIVER FLOOD CONTROL
TULLY DAM
TAILWATER RATING CURVE
U. S. G. S. GAGING STATION
NEW ENGLAND DIVISION BOSTON, MASS
AUGUST 1949





CONNECTICUT RIVER FLOOD CONTROL
MILLERS RIVER
NEAR WINCHENDON
RATING CURVE FOR
U. S. G. S. GAGING STATION
NEW ENGLAND DIVISION BOSTON, MASS
AUGUST 1949



CONNECTICUT RIVER FLOOD CONTROL
MILLERS RIVER
AT SOUTH ROYALSTON
RATING CURVE FOR
U. S. G. S. GAGING STATION
NEW ENGLAND DIVISION BOSTON, MASS
AUGUST 1949

GAGE HEIGHT IN FEET

7

6

5

4

3

2

1

0

0

1

2

3

4

5

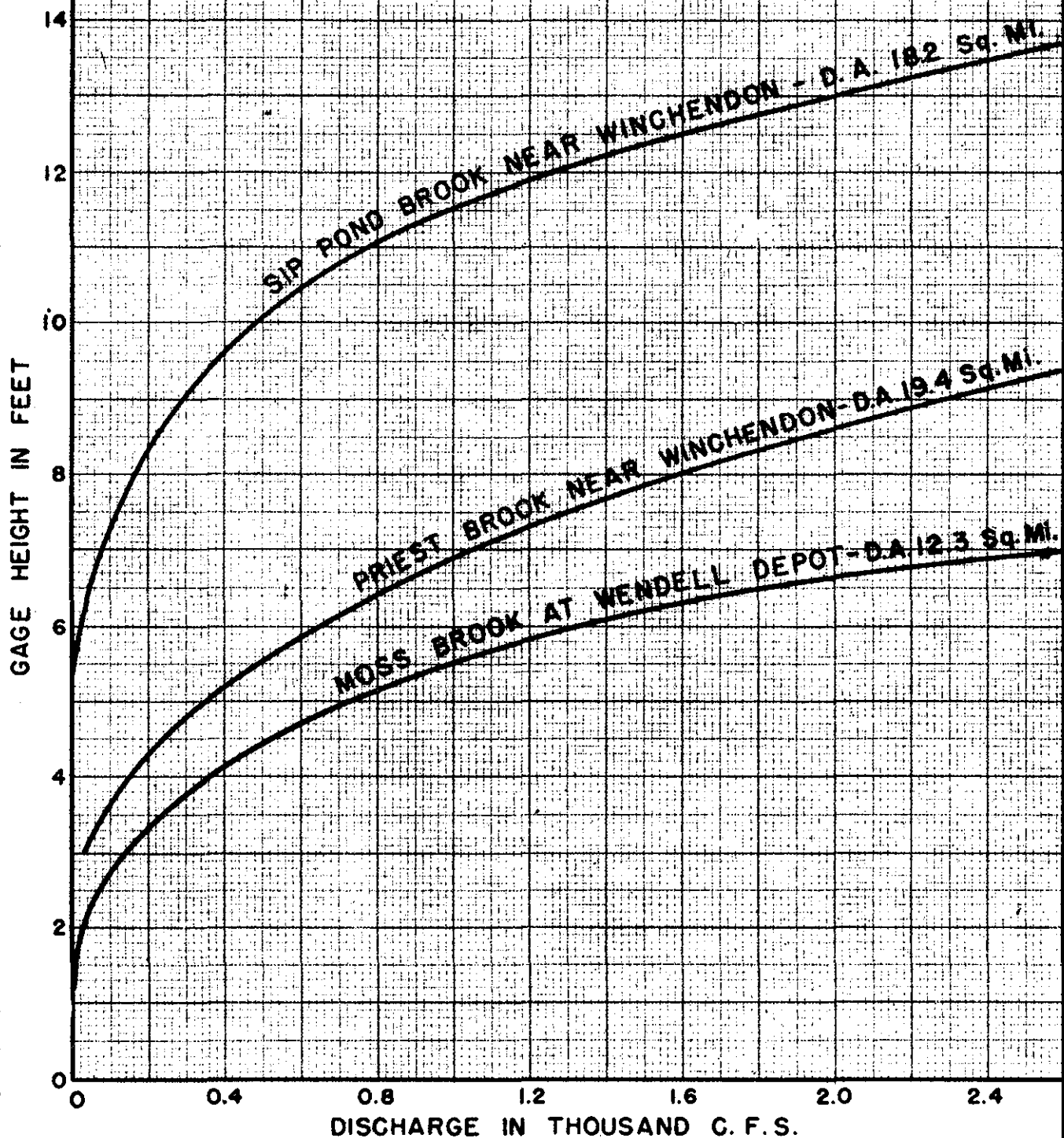
DISCHARGE IN THOUSAND C. F. S.

Drainage Area 375 Sq. Mi.

CONNECTICUT RIVER FLOOD CONTROL
MILLERS RIVER
AT ERVING
RATING CURVE FOR
U. S. G. S. GAGING STATION
NEW ENGLAND DIVISION BOSTON, MASS

AUGUST 1949

PLATE NO.22



CONNECTICUT RIVER FLOOD CONTROL
 MILLERS RIVER
 TRIBUTARIES
 RATING CURVES FOR
 U.S.G.S. GAGING STATIONS
 NEW ENGLAND DIVISION BOSTON, MASS

AUGUST 1949

PLATE NO. 23